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THE PROGRESS OF GEOGRAPHY IN THE UNITED STATES*

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The Slow Development of Scientific Geography.—Progress in geography among us has been markt by the extension and refinement of observation, and therefore also by a growing safety of generalization; and by a gradual change from an empirical to a genetic method of treatment, whereby our science has been brought under the philosophy

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of evolution; but curiously enough a great part of this progress has been accomplisht by the labors of others than professional geographers; geographers are indeed among our latest acquisitions, and until lately they came to us largely from non-geographical sources. But altho we have often been nurtured in other nests than our own, that does not mean that our few geographical forbears have abandond to others the duty of rearing their young, for it has been too generally the case that they had no young to rear; it is from the generous over-supply of fledglings in others' nests that many of us have come.

The period of our most significant progress followed the Civil War, when the great advance was made in the exploration of our wonderfully instructiv West; for it was then that we came more and more generally to understand that the world with which geography has to deal is not the product of a sudden and recent creation, but of a long continued existence during which an earlier order of things has been perpetually changing into a later order; and to understand also that in this perpetual change, all the facts and factors with which geography has to deal are in a greater or less degree interdependent, one on another. Assent may perhaps not be given at once to the late date, after 1865, when American geographers came to recognize that they had to do with an evolving order of nature, inorganic as well as organic, instead of with a fixt order, created in its present status; and truly that date would be too late if we were considering geologists and geology; but it is a curious fact that while geologists were making as early as 1800 excellent progress towards an appreciation of the evolving earth, American geographers seem to have long remaind unconscious of that progress; indeed, they were slow in awakening to it half a century later. If they knew anything of the reasonable processes of evolution even as concerning geology, the knowledge does not seem to have affected the treatment of their own science, which continued to be mostly empirical. The probable reason for this is that geography was seldom cultivated as a science at that time. It was dealt with chiefly by school teachers who had little outdoor contact with their subject, and little or no knowledge of geology or biology; or by travellers whose records were very largely devoted to personal narrativs.

The Early Work of Lewis Evans.—It must not be inferd, however, that the work of our early empirical geographers was of low value. Some of it was excellently well done as far back as 1755; for it was at that early time that Benjamin Franklin publisht Lewis Evans' "Analysis of a map of the Middle British Colonies in America," with a descriptiv text which contains some remarkably good

generalizations. Evans recognized that the land southwest of the Hudson " is more regularly divided into a greater number of stages" than to the northeast. He called attention first to " a rief or vein of rocks of talky or isinglassy kind, some two or three or half a dozen miles broad; and extending from New York City southwesterly by the lower falls of the Delaware, Schuylkill, Susquehanna, Gun-powder, Patapsco, Potomack, Rappahannock, James river and Ronoak. This was the antient maritime boundary of America, and forms a very regular curve. The land between this rief and the sea . . . may be denominated the Lower Plains, and consists of soil washed down from above and land accumulated from the ocean. . . . The substratum of sea-weed, shells, and other foreign objects is a perfect confirmation of this supposition." The plains are covered with " a white sea sand, about twenty feet deep and perfectly barren. . . . From this rief of rocks, over which all the rivers fall, to that chain of broken hills, called the South mountain, there is a distance of fifty, sixty or seventy miles of very uneven ground, rising sensibly as you advance farther inland, and may be denominated the Upland. This consists of veins of different kinds of soil and substrata some scores of miles in length; and in some places overlaid with little ridges and chains of hills."

Then comes the South Mountain, which " is not in ridges like the Endless mountains, but in small, broken, steep, stoney hills; nor does it run with so much regularity. In some places it gradually degenerates into nothing, not to reappear again for some miles"—thus it would seem that the lapse of this older Appalachian belt between the Reading and Cumberland prongs and its replacement by the lowlands of weak sandstones is indicated — " and in others it spreads several miles in breadth." Next is the Great Valley:— " Between South mountain and the hither chain of the Endless mountains . . . there is a valley of pretty even good land, some eight, ten, or twenty miles wide, and is the most considerable quantity of valuable land that the English are possest of; and runs through New York, Pennsylvania, Mariland and Virginia . . . The Endless mountains come next in order. They are not confusedly scattered and in lofty peaks, overtopping one another, but stretch in long uniform ridges scarce half a mile perpendicular in any place above the intermediate vallies . . . The mountains are all so many ridges with even tops and nearly of a height . . . They are very regular in their courses, and confine the creeks and rivers that run between; and if we know where the gaps are that let through these streams, we are not at a loss to lay down their most considerable inflections."

Thus this able observer announced the rectangular habit of Alleghany drainage, a habit which may be today briefly characterized, after the structure on which it has been developt is understood, as "adjusted." A later passage tells: "To the northwestward of the Endless mountains is a country of vast extent, and in a manner as high as the mountains themselves. To look at the abrupt termination of it . . . on the west side of Hudsons River, below Albany, it looks as a vast high mountain . . . These Upper Plains are of extraordinary rich level land, and extend from the Mohocks river through the country of the [Indian] Confederates. Their termination northward is a little distance from Lake Ontario; but what is the western is not known, for those most extensive plains of Ohio are part of them."

It is noteworthy that one of the few touches of explanatory treatment in these extracts from Evans' admirable work concerns the origin of the coastal plain strata as sea deposits. Apart from a brief mention of washt gullies in South Mountain, the origin of erosional forms is not considerd. But brief and incomplete as the explanatory treatment is, it appears to have been carried as far as Evans' understanding extended; and that is the case with our own work today. On the other hand, clear empirical statement is made of such features as the falls of the rivers next inland from the Coastal Plain, and the even crest lines of the Endless or Allegheny Mountains; the northeastern termination of the Endless Mountains in Pennsylvania is also intimated by the statement that the Upper Plains, or Plateau as we now call that division, advances to the Hudson valley below Albany. Evans was certainly the leading American geographer of his time.

The Lewis and Clark Expedition.—Many of the descriptions of the eastern and central part of our country written about the time of the War of Independence or not long after it might be cited in illustration of the status of geography in America at that period, but they would not differ greatly, unless in being of less value, from Evans' empirical account of the Middle Colonies. By far the most notable contribution of that epoch concerns the Far West, as described in the report on the great expedition of Lewis and Clark to the Pacific coast in the first decade of the nineteenth century.[1] These able explorers saw much new territory and brought back a great body of carefully recorded facts, but they do not seem to have been especially interested in either the observation or the description of the visible landscape. Their geographical vocabulary was limited, altho they had a great

[1] Original journals of the Lewis and Clark expedition, edited by R. G. Thwaites, New York, 1904.

variety of geographical features to describe. They must have lookt at many things which they saw imperfectly, and of the things that they saw many must have been described incompletely, because they had no good words with which to name them. But the really fundamental reason for the imperfection of their geographical records was that there was no comprehensive scheme of geographical science then in existence, in view of which the records might have been formulated; and as these two explorers did not seem to recognize the absence of such a scheme they made no conscious effort to develop it. This comment must not, however, be taken as imputing the slightest blame on two very notable men: they were pathfinders, not geographers; and they nobly accomplisht their duty, which was to go forth and come back, bringing as many sheaves of general observation as they could gather and carry.

Other Explorations in the First Half of the Nineteenth Century.— It was about the same with many later explorers of our western territory:[2] they added much to our general knowledge of the region, but the additions were seldom set forth in such a way as to contribute greatly to the scientific aspect of geography. Observd facts were usually recorded merely as so many separate items, unexplaind, unclassified, uncorrelated. Descriptions were extremely imperfect because the explorers had no geographic terminology available beyond that of their school days, except for the addition of mature but untechnical adjectivs: their accounts of the landscape were about on a par with what the account of the flora of a region would be by one who had only the most elementary knowledge of systematic botany. This is natural enough, for there were then no traind geographers available. Nevertheless, we were then growing geographically: how, indeed, could it be otherwise, in view of the rapidly accumulating records of geographical facts of many kinds, not only in the reports of western explorations, but also in the reports issued by the geological surveys of eastern states. It is still profitable to look over those old volumes in order to learn how greatly we are indebted to them for contributions to what is today a common stock of knowledge, and also to discover here and there early items of explanatory physiography, as in Dana's explanation of coastal embayments by the partial submergence of valleys; Hitchcock's recognition of the erosional origin of the Red River canyon in the Llano Estacado, which he thought from Marcey's descrip-

[2] A very serviceable map of the United States, "showing routes of principal explorers and early roads and highways," was prepared by Frank Bond of the U. S. Land Office in 1907 and publisht by Congress; it has been recently republisht on a reduced scale in Bulletin 689, U. S. Geol. Survey.

tion of it must have been "worn away by the river," instead of having been formed by "some paroxysmal convulsion;" of Blake's discovery that the deprest area north of the Gulf of California was nothing but the former head of the Gulf, cut off from the rest by the delta of the Colorado and laid bare by the evaporation of the enclosed waters; and of Newberry's penetrating revelation of the broad erosion that the Arizona plateaus had sufferd before the Colorado cut its deep course across them, an erosion which he regarded as "a much grander monument of the powers of aqueous action than even the stupendous cañon."

Eastern Geological Surveys.—If the many informing items found in the early geological survey reports of various eastern states publisht in the 40's and 50's are here past over, it is only from lack of time to quote them, and not in the least because their appearance in geological reports shows that they belong to geology alone instead of geography also: for we must remember that geologists have for over a hundred years past freely gatherd the foundation stones for the upbuilding of all the unobservable, speculativ part of their science—about 95% of their total stock—by observation of the visible facts in the unenclosed and little cultivated domain of geography, and have been perfectly right in doing so; but let us at the same time remember that geographers, now that they have awakend to the importance of cultivating their own domain, are perfectly warranted in taking over whatever is helpful to them from the well cultivated domain of geology, whether what they find there came from a geographical source or not.

What I must chiefly emphasize here is that the many informing announcements of a geographical nature, to be found in various geological reports publisht during the first half of the nineteenth century, were still presented for the most part only as uncorrelated items; and that they were very naturally then announced in geological reports, because there was no recognition of the possibility that there could be any such things as independent geographical reports. They accumulated in large volume, like the body of water which gathers and stands in a filling reservoir, but which has not risen to an outlet thru which it can flow forth in an organized stream. Hence up to the time when the American Association for the Advancement of Science was formd, and therefore until about half a century before the Association of American Geographers was establisht, geography in the United States was an unorganized subject, except insofar as the mere location of items was concerned. The greatest need of the science at that time was a reasonable systematization of its contents.

Guyot's "Earth and Man." — As in any other science, systematization of the content of geography should be lookt for in text books, but as the educational aspects of our subject are to be dealt with by another writer,[3] reference will be made here to only one book, Guyot's "Earth and Man." Arnold Guyot, a disciple of Ritter in Germany in the '30s and a colleague of Louis Agassiz in Switzerland in the '40s, followd Agassiz to Boston, where in 1849 he gave a series of twelve Lowell Institute lectures on geography. The lectures were deliverd in French from brief notes; but they were written out the next morning and at once translated into English by Felton, then professor of Greek and later president of Harvard College; and after being currently publisht in a Boston newspaper they were brought out with little revision in book form under the above title. The lectures made a strong impression on a body of intelligent hearers, as may be inferd from the testimonials on the prefatory pages of the book, which was widely read and taught in this country for two decades after the middle of the century and gaind recognition in Europe also. Guyot's former teacher, Ritter, was greatly pleased with it. The volume was pervaded by a spirit of rational correlation, and may therefore be regarded as having given us the first great impulse toward the cultivation of geography as a serious and independent science.

The book was, however, far from being a systematic and didactic text; it was rather a series of exhortations, in which certain fundamental principles were broadly and eloquently treated in lecture style. If we look back upon it in the light of our advance of seventy years, it seems to contain chiefly a series of elementary truisms: it is only by reading it in the darkness of its time that its great illuminating value can be seen. Its chapters had little or nothing to do with the details of locally visible landscapes, but dealt in a very general manner with the continents and their larger divisions: hence it did not promote local observation. Its great merit lay, first, in the emphasis that it gave to the correlation of man and nature, and second in the importance it attacht to an explanatory method of treatment. It is not too much to say that the rational or causal notion, which has in later years so largely characterized our treatment of the Earth as the home of man, was then implanted in our concept of geography. The philosophy of the book was of course teleological: for as a reviewer said at the time, the author "has shown that every peculiar formation, whether of a continent, an ocean, a sea, a mountain or a plain, is designed by the Creator for a special end, and is not a fortuitous assem-

[3] See article by Dryer, Annals of Association of American Geographers, September, 1924, No. 3, Vol. XIV.

blage of atoms." A great many facts had therefore to be fitted to a preconceivd conclusion: and yet, even if the meaning which we now find in nature and which we believe to be safely establisht on a very broad inductiv basis, is almost the opposit of that which Guyot accepted, we must acknowledge a great indebtedness to him for the principle of explanatory correlation which he introduced to us, very much as biologists today must acknowledge a great indebtedness to Agassiz for his embryological studies, as well as for the emphasis that he gave to first-hand observation, in spite of his persistent opposition to organic evolution.

Some of Guyot's sentences illustrate his principle very clearly. He wrote: "To describe, without rising to the causes or descending to the consequences, is no more science, than merely and simply to relate a fact of which one has been a witness" (p. 2). Again, geography "should not only describe, it should compare, it should interpret, it should rise to the *how* and the *wherefore* of the phenomena which it describes" (3). It is not enough merely to take "cognizance of the arrangement of the various parts" of the earth; geography "must endeavor to seize those incessant mutual actions of the different portions of physical nature upon each other, of inorganic nature upon organized beings, upon man in particular, and upon the successive development of human societies; in a word, studying the reciprocal action of all these forces, the perpetual play of which constitutes what may be called the life of the globe," geography "should . . . take up its physiology. To understand it in any other way, is to deprive geography of its vital principle; it is to make it a collection of partial, unmeaning facts; it is to fasten upon it forever that character of dryness, with which it has so often and so justly been reproached" (3).

Guyot's Insistence on Explanatory Treatment.— The context of these passages makes it clear that Guyot fully approved of an explanatory treatment for every topic of geography, from land forms at the foundation, up thru climate, to human activities at the top. He explicitly emphasized the great importance of the external forms of the earth, and insisted that in the changes they have sufferd they have a life, a "physiology" of their own, which the geographer must take account of (56). To be sure, the study of earth sculpture had not progrest sufficiently in Guyot's time to enable him to apply this vitalizing principle very far; but, like Evans, he applied it as far as he could. It is chiefly his teleological philosophy which we give up, while we extend his physiographic base and his ontographic responses. We cannot longer say, as he did, that "inorganic nature is made for organized nature, and the whole globe for man," because we do not

feel that we have penetrated far enough into the meaning of the universe to warrant such a statement. And just as zoologists can no longer follow Agassiz in regarding the main divisions of the animal kingdom as revealing a scheme of creation, so geographers cannot now follow Guyot in saying: " The forms, the arrangement, the distribution of the terrestrial masses . . . accidental in appearance, yet reveal a plan . . . The continents are made for human societies, as the body is made for the soul " (16); but we do still follow him in trying to discover every discoverable meaning in the facts of geography; and we agree with his main contention: " It is as the abode of man and the theatre for the action of human societies " that we must consider the continents and the physical features which distinguish them; for thus considerd, " all the forms they present acquire a new meaning and a new aspect " (12).

It was perhaps more because of the plan of treatment adopted for a course of public lectures than from any lack of interest in the smaller forms of the land that Guyot's book is so largely concernd with great terrestrial features; and we may believe that, had he treated the smaller forms, he would have attempted to " rise to their causes and descend to their consequences;" but he did not then make that attempt; he treated chiefly continents and oceans. Thus he said: " The Pacific ocean seems an immense basin sunk in, the broken and elevated edges of which present on all sides the abrupt termination of the continents. On this great line of fractures . . . we behold the great majority of the active volcanoes of our globe, arranged like an immense burning crown. The Atlantic ocean, on the contrary, would be a simple depression, somewhat in the form of a trough, owing, perhaps, to a lateral pressure, and in part to a tilting motion which raised the lands in the neighborhood of the Pacific . . . Thus, then, gentlemen " — for so, in lecture fashion, the paragraph continues — " a great law, a general law, unites all the various systems of mountains and plateaus, which cover the surface of our globe, and arranges them in a vast and regular system of slopes and counter-slopes," the longer, gentler slopes toward the smaller ocean, the shorter, steeper slopes toward the greater ocean (52, 53). "All is done with order and measure, and according to a plan which we shall have a right to believe was foreseen and intended."

The organic consequences following from the form and arrangement of the continents were also treated: the community of animal life around the almost confluent northern continents was contrasted with the lack of community on the southern continents (223, 224); and it was even declared that " the three continents of the North are organ-

ized for the development of man . . . The great tree of humanity germinates and sends up its strong trunk on the ancient land of Asia. Grafted with a noble stalk, it shoots out new branches, it blossoms in Europe. In America only, it seems destined to bear all its fruits" (305). If in this ambitious and to us flattering ascent to the causes and descent to the consequences of continental arrangement, some missteps were made, let us not be distracted thereby from the essence of Guyot's method, which manifestly was to introduce a rational, explanatory treatment into a subject that had been so generally treated in an empirical manner.

It was, however, by no means only thru his "Earth and Man" that Guyot aided the progress of geography in America. As an agent of the State Board of Education of Massachusetts he addrest a great number of teachers and inspired them with his views; as professor of geology and geography at Princeton from 1855 until his death in 1884 he arousd a new interest in earth-science among his students; as a persevering explorer of the Appalachians from the White Mountains of New Hampshire to the Black Mountains of North Carolina, he gave a greatly increast precision to our knowledge concerning them; as a trusted friend of Henry, then secretary of the Smithsonian Institution, he had a large part in the establishment of systematic meteorological observations at many stations; further as author of a small treatise on physical geography, publisht in an edition of Johnston's Atlas in 1873, he gave new attraction to that old subject; and his text book of geography, in which special supplements were provided for several different states, reacht the pupils of many schools in his later years, as his "Earth and Man" had reacht many teachers in his earlier years among us.

It was natural enough that his lectures of 1849 should not have treated topographic features in detail; but it is somewhat disappointing to find that even in his later studies little application was made of his vivifying principle that the changes which land forms have sufferd ought to be taken into account in their description. In his explorations of the Appalachians, to which he gave many summer vacations for over 30 years, he was less concernd with their individual forms than with their general configuration and their height, in the determination of which he made over 12,000 barometric observations. His descriptions of the mountains[4] are characterized by a scanty and elementary terminology; the treatment is largely empirical, and little

[4] On the Appalachian Mountain system. Amer. Journ. Sci., xxxi, 1861, 157-187. The manuscript of an unpublisht essay on "The mountain district of western North Carolina" is preservd in the library of the U. S. Geological Survey.

attention is paid to the human element. His Physical Geography attempted the double duty of systematic and regional presentation in small compass, and therefore could not present the landscape aspect of either treatment.

When one reflects on the high position which Guyot gaind among the scientific men of his time, on the popularity of his writings, and on the solid value of his principles and his teaching, it seems curious that, in spite of his holding a professorship of geography at Princeton for a generation — probably the only college professorship of the subject then establisht — very few of his pupils became professional geographers. The reason for this is probably that no demand for geographers then existed; he was ahead of his time.

Note may be here made that Shaler, 50 years after the appearance of Guyot's "Earth and Man," brought out a similar book, "Earth and Man in America" (1899). Its interest in the present connection lies in the extension that it gave to the rational correlation of earth and man, introduced to us in Guyot's book half a century before.

Lesley and the Topography of Pennsylvania.— An epoch-making step in what may be calld the anatomical study of land forms was made by the geologists of Pennsylvania in the middle years of the nineteenth century; and this step was itself an example of the correlation of man and the earth; for it was as natural that the marvelous interdependence of understructures and surface forms there exhibited should be the object of special study by the geologists under Rogers in the Keystone state where the strata are folded and not rich in fossils, as that the relation of stratigraphy and paleontology should be the object of special attention under Hall in the Empire state, where the topography is comparatively simple, and where the nearly horizontal strata are loaded with fossils like the shelves of a well-stockt museum.

The formal announcement of the facts concerning Pennsylvanian rock formations and topography was made in Roger's quarto report in the Geology of the State; but it is particularly to Roger's assistant, Lesley, himself director of the Second Geological Survey of the state in later years, that we owe a more attractiv presentation of the dependence of form upon structure; for his little book, "A Manual of Coal and its Topography" (1856), is a classic. There the linear ridges of the Endless Mountains, as they were calld by Evans a century earlier, are shown to be in reality of zigzag pattern, with sharp turns and long tangents, developt on the resistant members of a heavy series of closely folded strata with gently pitching axes. The resistant strata stand in relief while the weaker strata between them are excavated in lowlands. Certain simple relations of understructure and surface form

had been explaind by Hutton in his "Theory of the Earth" fifty years before; Lesley showd that Hutton's fundamental principle still holds good where the relation of structure and form is complicated. The value of this extension of Hutton's principle must be measured, not by the readiness with which it now enters our still more extended schemes, but by the advance which it then made in a little developt subject. As a matter of fact, the physiographic features of Pennsylvania were found to be so striking that the geologists there became in large measure geographers.

Lesley tells of the explorations carried on by his colleagues and himself with glowing enthusiasm: In the absence of rare minerals and abundant fossils, "nothing remained to study but dynamic forms; and these so numerous, so grand, so variously grouped that they excited a perpetual enthusiasm and led on to infinite research. . . . They were a world of the exhibition of natural forces by itself, and as such we took possession of it and settled in it as our fathers did in the valleys themselves, and thus became, not mineralogists, not miners, not learned in fossils, not geologists in the full sense of the term, but topographers, and topography became a science and was returned to Europe and presented to geology there as an American invention" (124). This son of Pennsylvania delighted in the striking topographic individuality of his state: "Nowhere else on the known earth is its counterpart for richness and definiteness of geographical detail. It is the very home of the picturesque in science as in scenery. Its landscapes on the Susquehanna, on the Juniata and Potomac are unrivalld of their kind in the world;" a bold statement, yet still a true one, altho certain mountains in northwestern India and in northwestern Africa are competitors.

The rapid progress made by Lesley and his associates in the interpretation of form as an expression of structure causd them to be impatient with the hesitating advance of their European contemporaries in smaller problems of structural geology. The zigzag ridges of Pennsylvania were seen to be the surface expression of structures "so vast that to our eyes, familiar with rock curves ten and twenty miles in radius, underground or in the air, all that customary European local research which filled the proceedings of societies in lieu of new and larger matter seemed tedious and puerile . . . Years of patient toil it cost us to unfold the mysteries of the Pennsylvanian and Virginian range — a tangled hank, to be untangled thread by thread and rearanged skein by skein — a tracery more elaborate and intricate than Gothic or Arabesque — nature's primeval labyrinth, in which the Minotaur was but a form of science cast in metal and sculptured in

stone." The magnificent group of zigzags seen in the Seven Mountains west of the middle Susquehanna, where seven successive anticlines of resistant sandstone pitch gently eastward, was declared by Lesley to have "no rival yet known upon the surface of the earth," and the declaration is still valid.

Thus did the Pennsylvania geologists, and Lesley most of all, establish in America the great principle that surface form is intimately related to the rock structures beneath it; but the principle was establisht more for local use than for world-wide application, and little or no attention was paid to the geographic correlations into which the physiographic features enter. Indeed, the principles involvd were imperfectly generalized, and their larger consequences were not systematized with respect to time. It seemd sufficient to elaborate numerous instances of unlike forms dependent on unlike structures, and to treat each structure as if only one form could be produced on it, instead of as if a whole succession of forms must be produced as time passes. Unlike Guyot, who insisted that all land forms have a "physiology," a life of their own, without giving small-scale examples in support of his assertion, Lesley gave many examples of structure-controld form but did not present them as members of an evolving series. Guyot generalized certain phases of the problem without really solving them; Lesley solved certain phases but did not generalize them. Yet even without generalization he opend the way to an understanding of the smaller features of the visible landscape, which when integrated make the continents; thus did he contribute greatly to a fuller appreciation of some of the inorganic features which enter into the correlations that unite earth and man.

It is well that Lesley's results were studied by young geologists half a century ago; it is unfortunate that the young geographers of the same period — if there were any such — did not also become familiar with them. Probably because so little use was then made of the Pennsylvania ridges as geographical types, they are still generally associated with geology alone. This is truly regrettable, for as a result the fundamental principle that surface form is always related to understructures was delayd in gaining recognition. Indeed, the production of the zigzag ridges that traverse the Susquehanna and Juniata valleys by the differential erosion of strongly folded and gently pitching anticlines and synclines is a problem about which our geographers are even today unduly timid; it is as if they feard they would become geologists if they adopted such an explanation, or as if the concept of eroded anticlines and synclines were too difficult to be comprehended by their students; yet it is just as appropriate to include men-

tion of anticlinal and synclinal zigzag ridges in a geographical account of Pennsylvania as to include mention of retreating escarpments of nearly horizontal sandstones in an account of the high plateaus of Utah, or mention of denuded volcanoes and lava flows in an account of central France, or mention of drumlins and proglacial river channels in an account of western New York, or mention of the deltas of the Nile and the Ganges in accounts of Egypt and India: for all such matters enter perfectly into the explanatory treatment of the physiographic base of geography. The difference between simple and complicated problems, or between problems of ready and of difficult solution, may be properly considerd in selecting examples for elementary and for advanced classes in schools and colleges, but such differences have no value in determining to what science a problem belongs! Zigzag ridges should be represented by types in systematic physiography, along with many other types, in order to provide the necessary mental equipment with which a physiographer goes forth to his field studies. It is a loss if we fail to utilize this lesson which Lesley taught so well.

Just as Guyot taught the correlation of earth and man under the erroneous principle of biological teleology, so Lesley taught the correlation of structure and topography under the erroneous principle of geological catastrophism; and that is rather singular, for when he wrote his "Manual" he had already gaind an understanding of the slow but important process of soil creep, and was indeed one of the first observers anywhere to understand it. He wrote: "The whole surface [soil] of all hills has been in slow but perpetual movement downward from the beginning;" but he seems to have thought that the "beginning" followd the production of the larger reliefs by a vast ocean flood, rushing from the Arctic regions; a flood which he believd had workt "with infinite force and speed, and then ceased forever!" He was very positiv about this: for the field worker "the rush of an ocean over a continent . . . leads off the whole procession of his facts and is indispensable to the exercise of his sagacity at every turn." He held that the Delaware wind gap, a half-depth notch in the even crest of Kittatinny mountain west of the Delaware water gap, "furnishes unanswerable proof that no water now running made a gap; in other words, proves the cataclysmic origin of every mountain gorge in the land." Fortunately, he learnd better and corrected this error some ten years later, in an essay which again emphasized the importance of the relation between structure and form, but which properly explaind the relation as brought about by the slow processes of erosion;[5]

[5] . . . . Five types of topography in the United States . . . Trans. Amer. Phil. Soc., xiii, 1866, 305-312, with map.

but in this his work was soon distanced by that of Powell and Gilbert in the West, as will be noted below.

Climate and Weather.— A section must now be devoted to climate and weather as constituting one of the most important divisions of Geography. Among earlier contributions, reference may be made to three inductiv studies: Blodgett's summary of our climates,[6] a serviceable compilation tho necessarily incomplete; Maury's tabulations of weather observations at sea, which contributed so greatly to the knowledge of ocean meteorology and to the best utilization of prevailing winds by sailing vessels; and Coffin's memoir on the winds of the Northern Hemisphere,[7] a laborious and meritorious work. More significant by reason of their deeper penetration into meteorological processes were the inductiv and deductiv studies of Redfield and Espy before, and of Loomis and Ferrel after the middle of the century. Redfield and Loomis were the more inductive of these four, and gave us our best earlier and later knowledge of the observd behavior of winds in cyclonic storms; Espy and Ferrel followd for the most part deductiv methods in applying well establisht physical principles to the special problems of atmospheric movements, thus developing a greatly increast understanding of the way the winds work. The labors of these four men were in every respect distinctivly American,[8] and they were performd at a time when next to no training in meteorological investigation was provided in our colleges: hence each of the four men was essentially self-developt. It was his own keenness of insight that led Redfield, a little later than but entirely independently of the similar work done by Dove in Germany, to generalize the scatterd records of a cyclonic storm in 1831, and thus to demonstrate on the basis of many independent observations the whirling of its winds in almost circular courses around a center that moved eastward; just as it was Franklin's keen insight that had led him, nearly a century earlier, to prove that our northeast storms came from the southwest, a principle that was so far in advance of Franklin's time that it lay dormant until Redfield came upon it again. Today, when the weather maps make it easily possible for a high-school pupil to work out the behavior of the weather, we can hardly appreciate the revolution that Redfield's discovery made in our understanding of weather changes; from arbitrary local happenings, they became orderly and progressiv phe-

[6] L. Blodgett, Climatology of the United States and of the Temperate Latitudes of the North American Continent, Philadelphia, 1857.

[7] Coffin. The Winds of the Northern Hemisphere, Smithson. Contribs., No. 52, 1852.

[8] See my essay:—Some American contributions to meteorology. Journ. Franklin Inst., cxxvii, 1889, 104-115, 176-191.

nomena, on which the technique of weather prediction is now so well based. Redfield also correctly explaind the greater velocity of the winds near the center of cyclones and tornadoes as a consequence of their being drawn in toward the axis of gyration, in accordance with the law of the conservation of areas.

On the other hand it was Espy's brilliancy of deductiv inference which led him to believe that storms must be convectional phenomena, and hence that their winds must be chiefly centripetal rather than circular; thus arose a controversy in which more heat was developt than should have been during the discussion of an aerial problem in which the air itself is adiabatically coold: and here another name may be introduced in this review of progress: that of Charles Tracy, then a young graduate of Yale, afterwards a well known lawyer in New York, who brought forward the true solution of the controversy in a timely article;[9] and yet, in spite of the clearness and pertinence of his argument, it did not have the share in settling the controversy that it deservd. Nevertheless, Tracy successfully explaind that the centripetal inflow, inferd by Espy, must be transformd into the nearly circular whirl discoverd by Redfield in consequence of the deflectiv effect of the earth's rotation, which he correctly showd to be independent of azimuth and to increase with the sine of the latitude, as certain mathematicians had done before him; but he appears to have been the first to apply this principle properly to a meteorological problem. Redfield's further work was largely devoted to collecting additional data concerning cyclonic storms, but Espy took up a variety of problems and carried many of them so far that, in after years, European meteorologists exprest their astonishment on learning how fully he had anticipated some of their later solutions; indeed, it is very largely to Espy that the first rational interpretation of various atmospheric phenomena is due, such as the mechanical or adiabatic cooling of rising and expanding air currents, the retarded cooling of such currents as soon as the condensation of water vapor begins, the warming of descending air currents by compression, and hence the clearness of such currents and the impossibility of explaining cold winds by the cold of the upper atmosphere; also the production of clouds and rain when winds encounter a mountain range, not by the cold of the mountains or of "the upper regions," but by the adiabatic cooling of the air as it rises to pass over the range; the day-time increase of wind-velocity as a result of convectional overturnings; and the dissolution of clouds in the central space or "eye" of tropical cyclones as consequence of a down-

[9] On the rotary action of storms. Amer. Journ. Sci. xiv, 1843, 65-72.

settling of the central air. This is truly a brilliant record for one man to make.

Loomis continued Redfield's work: one of his earliest studies concernd a cyclonic storm in 1843, the records of which he laboriously gatherd by personal correspondence from such observers as he could discover: it was then he exprest the wish that daily observations of the weather might be brought together on a synoptic chart; a wish that was partly realized after 1848 in the records secured, in part by telegraph, under the able leadership of Henry, first secretary of the Smithsonian Institution; but the wish was fully realized some twenty years later when the Signal Service of the Army undertook the work of weather prediction in 1871, and when the first predictor was Cleveland Abbe, who had been previously conducting a small weather service of his own in Cincinnati, but whose modest eminence in his later contributions to meteorological science never reacht public prominence. It was upon the great body of observations summarized on the tri-daily weather maps thereafter issued that Loomis based his famous statistical studies of the behavior of cyclonic and anticyclonic areas, and thus produced one of the best examples of inductiv procedure anywhere to be found: his generalizations still serve as a well authenticated basis of our knowledge of weather changes; they have not been significantly changed by additional studies of similar nature carried on by the Weather Bureau.

In the meantime, Ferrel, who was a farmer boy in Pennsylvania drew geometrical diagrams on a barn door, using a pitchfork for a compass and a shingle for a ruler, later a mathematics teacher at Nashville, Tennessee, developt the first approach to a rational theory of the general or planetary circulation of the atmosphere by a well argued deductiv method; a theory which he offerd as a substitute for the physically fantastic scheme proposed by Maury, and which thus gave a reasonable explanation for various large phenomena, such as the belt of high atmospheric pressure around the meteorological tropics and the reduced pressure of the polar regions. Later when Finley had announced, on the basis of a purely inductiv study of the weather maps, that tornadoes occur in the southeast quadrant of cyclonic areas, Ferrel showd deductivly that under the atmospheric conditions there prevailing the enormous concentration of energy in a tornado whirl could be accounted for on valid physical grounds. His explanation of the planetary circulation appears, however, to need modification in view of later studies of the upper air, to which the contributions of our Weather Bureau have been notable. By none of these able investigations were finalities reacht, nor are finalities yet

reacht by their successors, but the great progress made by the above-named earlier and later pairs of meteorologists, an inductiv and a deductiv mind in each pair, was so great that we may well be proud of it.

To return to climatic studies; in addition to the occasional long-period records maintaind by patient and persistent unofficial observers, there has now been gatherd, first under the Signal Service of the Army, then under the Weather Bureau of the Department of Agriculture, an immense mass of records from which the mean values of various climatic elements have been determind by routine methods. The utilization of these values in such studies as those by Ward adds much to our knowledge of the average conditions under which we live. The extension of weather and climatic studies by cooperation with the appropriate bureaus of other nations, so as to embrace the greater part of the northern hemisphere with a view to gaining a better understanding of world weather and of long-range forecasting, has long been recognized as an important responsibility of our Weather Service, and many contributions have been made to this great subject. The Hydrographic Office of our Navy, continuing the work introduced by Maury, has taken an activ part in determining the mean values of climatic data over the oceans, well summarized in the Monthly Pilot Charts, on which so great a body of information is compactly condensd. Mention should also be made of the high-class studies carried on at the meteorological observatory establisht on Blue Hill, near Boston, by Lawrence Rotch, and now associated with Harvard University, as well as of many creditable contributions made in recent years to the physics of the upper air in connection with aviation, altho the problems there encounterd lie somewhat above the plane of geography. But with regard to three other classes of studies, our progress has been less notable. One class includes the smaller weather phenomena, the study of which demands an observational network of finer meshes than that of the Weather Bureau; a beginning made on the study of thunderstorms by the short-lived New England Meteorological Society in 1884 and 1885, and of sea breezes a few years later, has had little continuation. Another class of studies includes a variety of large-area, non-periodic weather phenomena, like cold waves, which are noted by the Weather Bureau observers, but which are lost or at least obscured by the ordinary method of calculating daily and monthly means. A third is concerned with a closer correlation of climatic elements with human activities, in which much remains to be done, but in which Huntington's recent studies[10] are an encouraging beginning.

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[10] Ellsworth Huntington. Civilization and Climate. New Haven, 1915.

As the advances made in these various lines are carried on to a fuller development, it may be predicted from the progress already made that the future geographical treatment of all climatic data, whether they are monthly means or non-periodic elements, will have an increasing regard for their position in the great terrestrial total, rather than for their merely local occurrence. For just as a general account of central Kentucky would describe its streams as members of the Mississippi system, so its temperatures and its winds and its rainfall should be described as parts of the great terrestrial system to which they belong. A local climatic area will then be conceivd as occupying its true place in the world.

Geographical Societies.—The contributions to the progress of geographical science made thru geographical societies in the United States, the oldest of which was founded a few years after the organization of the American Association, have not been of great importance until recent years, because, as is so generally the case with such societies all over the world, they are more interested in popular accounts of travel and exploration than in scientific accounts of study and investigation; they have as a rule been more arousd by the discovery of an island or by the first ascent of a mountain than by the announcement of a new geographical principle. Their interest in the concrete and specific side of geography has, however, always been of importance thru the encouragement thereby given to the exploration, scientific or otherwise, of new regions. But today the popular and the scientific aspects of geography have been developt with such extraordinary success by our two leading geographical societies that they must be considerd national assets of the highest value, one happily complementary to the other and each the indisputabl leader in its own field. The younger one of the two, The National Geographic Society of Washington, developing with marvelous success the pictorial and popular sides of our science, has captured the attention of the world by its magnificently illustrated magazine, of which nearly a million copies are printed every month, and every issue from first to last a perfect product of the highest art of printing; the society thus derives a large income for the support of its scientific work. The older one of the two, The American Geographical Society of New York, little known to the public but recognized as a center of studious investigation wherever geography is scientifically cultivated, is at present not only publishing a valuable quarterly Review, but is concentrating its attention with markt success on summarizing in a convenient manner, in both verbal and graphic form, everything geographical that is now known of Latin America. Each of these societies has also had to do with a

large-scale geographical excursion of international membership which contributed to progress by imparting information about our country to eager recipients, if in no other way. The International Geographic Congress of 1904, which was held in this country on the initiativ of the younger of the two societies, opend its peripatetic sessions in Washington, and before dissolving had edified some of its foreign members by guiding them to points as far distant as the Colorado canyon and the City of Mexico. The Transcontinental Excursion of 1912, by which the older society celebrated its sixtieth anniversary, carried its sixty or more members for eight weeks in a commodious special train over 13,000 miles, and thus made many features of the United States known to a select body of European geographers, and at the same time made those European geographers known to a good number of their American colleagues.

Another geographical society, the Association of American Geographers, founded half a century later than the earliest, deserves mention as being, in its inconspicuous way, as well individualized as the other two much greater societies; for it is believd to be the only geographcal society in the world which limits its membership, as astronomical and geological societies usually limit theirs, to proficient and productiv workers in its own field. The organization of this small society, even now with a membership list of less than 150 names, may be regarded as one of the greatest steps of geographical progress yet made in America. The power for scientific good that geographical societies may exert, not only in the way of fostering studious investigation but also in encouraging and supporting distant exploration, is so great that it is to be hoped that others than the half a dozen or more such societies now existing in the United States may be soon establisht.

Foreign Exploration. — Americans were so largely occupied during the nineteenth century in exploring their own country that the share they then took in exploring the rest of the world was comparativly small. Nevertheless, American whalers are to be credited with the discovery of various small islands in the Pacific, and in so far as mere discovery without description is a geographical feat they deserve honorable mention. Our Navy has done more in this direction than most of us remember; for besides making innumerable surveys and soundings of special areas in all the oceans, the "Vincennes" went round the world, touching at various little-known islands, in 1829 and '30. All honor to her record at the Marquesas! The United States Exploring Expedition under Wilkes in the late 30's and early 40's added much to our knowledge of the Pacific and Antarctic oceans; the Amazon and the Rio de la Plata were surveyd by naval vessels at somewhat

later dates; a North Pacific Exploring Expedition was sent out in the '50s, in which the "Vincennes" again took part; two voyages to the Arctic were later undertaken; and the "Nero" made some of the deepest soundings in the Pacific in 1899-1900.

The share taken by the Navy in deep-sea sounding deserves further mention, for it has been of great import from the early time when Brooke first invented the detachable sinker for sounding lines, to the later time when Sigsbee showd that piano wire makes a better sounding line than heavy hempen rope, and to the latest time when the sonic depth finder — an outcome of experimentation during World War for the detection of submarines, recently perfected by Hayes, first at the Naval Engineering Experiment Station at Annapolis and now at Washington — uses the time interval between a surface sound and the return of its echo from the ocean bottom to determin the depth, without dropping a line and without stopping the ship. A trial of this remarkable device in a voyage across the North Atlantic in 1922 demonstrated its practical usefulness and great value, tho a significant correction of its measure must be made to allow for the slanting return of the echo where the bottom happens to be strongly inclined, and smaller corrections may need to be made on account of variations in the velocity of sound with variations in temperature and density of deep ocean water. The most remarkable product of this instrument is a contourd and colord bathymetric chart of the very uneven sea floor off the coast of southern California, prepared by the Hydrographic Office at the request of the California Earthquake Commission and publisht in 1923; unfortunately the chart gives no indication of the points at which soundings were taken, and hence the accuracy of its contours cannot be judged without going back to the original records. One of the latest uses of this instrument, which is now instald on a number of naval vessels, was the attempt to make a section across the Pacific from San Francisco to Sydney by the cruiser, "Milwaukee," in the summer of 1923; the presentation of the section to the Pan-Pacific Scientific Congress, which was in session at the port of arrival, duly imprest the representativs of various nations there in attendance with the importance of the new instrument for ocean exploration.

Excellent charts of parts of the coast of Cuba and of the American-Samoan island of Tutuila have also been prepared recently by the Hydrographic Office of the Navy; and the publication of ocean and coast charts of the world, reproduced by this Office from various foreign sources, has been greatly increast in recent years; some of the latest additions to this collection are given a greatly increast legibility

by tinting the land light buff, and on-shore water, less than 2 fathoms in depth, light blue.

Other departments of the government have likewise made important contributions to our knowledge of distant tho not in all cases of foreign lands. Prominence should be here given to the exploration and partial mapping of Alaska, and to the detaild mapping of Oahu, Kauai, and parts of Hawaii by the U. S. Geological Survey; also to the mapping of parts of Hayti by topographers from the same Survey, temporarily in the employ of the Haytian government; likewise to the admirable coast charts of Alaska and the Philippine islands prepared by the U. S. Coast and Geodetic Survey. The fundamental studies of this Survey regarding the figure of the earth and the isostatic condition of its crust should not be overlookt.

Distant exploration by independent American travelers must also be noted. A good number of them have braved the dangers of far northern journeys from the early days of Kane, to the later ones of Peary, who so perseveringly penetrated that part of the frozen Arctic which possesses a geometrical interest because there the earth's axis emerges, and of Stefansson, who so successfully survived Arctic exposure by learning how to adapt himself to it. Among explorations in other regions mention should be made of Squier's travels in Central America and Peru, of travels in various parts of South America by Church, Heath, Herndon, Rice and Roosevelt, of Branner's long continued studies of Brazil, and of Hatcher's journeys in Patagonia; of travels in Africa by Donaldson Smith and Shantz, and of archeological exploration in the Near-East by Sterrett and Olmstead; of Alexander Agassiz' voyages over many oceans, partly in government vessels, partly in vessels charterd by himself, with especial regard to the life of the deep sea and to the origin of coral reefs; of Pumpelly's early exploration of China and of his later archeological examination of Turkestan, of Willis' geological and physiographic reconnoissance in China, and of Bauer's magnetic survey of all lands and seas — these last three undertakings having been supported by the Carnegie Institution of Washington; of the ornithological survey of the Andes by Chapman and others, and of the exploration of Mongolia by Andrews and others — these being two of the greatest of the many distant expeditions sent out by the American Museum of Natural History in New York; of Rockhill's penetration of inner China and of Huntington's traverse of Chinese Turkestan; of Bowman's studies of the Bolivian and Peruvian Andes under the auspices of Yale University and the American Geographical Society; of the studies of Alaskan glaciers by Tarr and Martin, of the archeological study of Peru by Bingham, and of the

repeated visits to the scene of the great Katmai volcanic explosion by Griggs and others — these three being conducted under the auspices of the National Geographic Society of Washington; and of studies of the Galapagos and other eastern Pacific islands by the California Academy of Sciences. Here may be mentiond also, as fostering geographical studies of their respectiv continental and oceanic fields, the Pan-American Scientific Congresses, of which the third was held in 1924, and the Pan-Pacific Scientific Congresses, of which the second met in Australia in 1923. Furthermore, all the continents have been penetrated of late years by expert American observers in search of gold, coal, iron and oil for exploitation companies, but unhappily for the interests of science, the geographical results of this kind of exploration are often withheld from publication.

Western Geological and Geographical Surveys. — Fifty or sixty years ago, in the period of rapid expansion following the War of the Rebellion, there was a short-lived era of rival surveys of the vast public domain in what was then the "Far West," soon followd by the more orderly and enduring period that was usherd in by the organization of the United States Geological Survey. Geography has profited greatly as a result of the unified direction of national geological research in the second of these periods, as will be further told below, but it made very significant advances during the shorter and earlier period of rivalry as well. Most of the western surveys of that time were organized under one or another department of the national government and approacht their field from the East: but one survey of local western origin also deserves mention, namely, the Geological Survey of California under Whitney, for altho that state was then only in its teens, it embarkt upon an investigation of its natural resources and its geographical features were given especial attention;[11] but the plan of investigation seems to have been exalted above the comprehension of the state legislature, and the survey was of short duration.

The geographical contributions of the rival departmental surveys were of two kinds. First, many facts of a geographical nature were then made known, even tho their announcement was reported in such various ways as suited the rather accidental habit of preference of the reporter: a volume would be required merely to summarize these facts, so numerous were they and so varied. Second, the principles exemplified by the facts and the best method of reporting the facts were occasionally studied, but these studies were so far in the minority that a short chapter might include a sufficient summary of them: yet

[11] As an early example of a geographical product of the California State Survey, the "Yosemite Book" merits attention.

it is hardly too much to say that such a chapter of principles is of broader significance to the scientific world than all the volume of facts. The itemized facts, as such, are of little more than local value; the generalized principles are of universal application; they give vitality to inert matter. Far be it from me to show lack of respect to any fact of occurrence, but it is safe to say that, apart from such sensational phenomena as the geysers of the Yellowstone Park and the Grand Canyon of Colorado, few if any other geographical features of the West then described attracted so much attention from geographers as did Powell's generalizations regarding the baselevel of erosion and river classification, and Gilbert's discussion of fault-block and laccolithic mountains and of the processes of land sculpture. It is, however, curious to observe that, of all the rival surveys, the one that was intended to give the most prominent place to geography had little influence on the later progress of that science as far as the work of its leader is concernd; and the reason for this seems to be that his treatment of geographical features was characterized, apart from much good work in the determination of positions by astronomical methods and in the production of a number of hachured maps, by an unenlightened empiricism: it struck no spark that kindled into flame.

Powell and Gilbert. — It is profitable to inquire how it happend that the exceptionally able investigators, Powell and Gilbert, whose field studies were thought to have geology for their prime object, should have contributed so largely to the neighboring science of geography. Two factors determind this result. One factor was that neither Powell nor Gilbert had had any considerable measure of geological training before he enterd the western field: hence they were little trammeld by the conventions of geological science as it was then developt, and were consequently freer than they might otherwise have been to entertain new points of view, and to develop new lines of thought appropriate to their new fields of work; and as this freedom was coupled with exceptional powers of observation and of generalization, it resulted in notable progress. The other factor was that the region which they explord was a part of the Great American Desert — a vast region which gaind wide-spread popular recognition under that name 70 years ago, only to be maskt in later years under other names more likely to favor settlement, but which nevertheless still exists in tremendous and formidable verity — where, in the absence of a cloak of vegetation, the relation of understructure to surface form was so manifest that it was forced upon their attention. Hence in the Far West, as in Pennsylvania, the would-be geologists were inclined toward that phase of geography which has to do with the forms of the lands,

and even more than in Pennsylvania was the inclination fruitful; for in the West not only many facts of occurrence, often of greater magnitude than, tho seldom of so great complexity as the zigzag ridges of Pennsylvania, were given local explanation, but the general principles by which those impressiv facts were to be accounted for thru the action of erosional processes conditiond by structure and altitude were developt with extraordinary success.

A third favoring factor deserves mention: the principles of land sculpture formulated and exemplified in the West were announced at a time when the violent old doctrine of catastrophism was rapidly losing ground before the advance of the gentler doctrine of uniformitarianism, liberally interpreted; and at a time also when the old doctrine of special creation in the organic world, a congenial associate of the doctrine of catastrophism in the inorganic world, was yielding to the newer doctrine of organic evolution. The geological world was therefor favorably disposed toward a rational treatment of geomorphology or the science of land forms, and even the geographical world, which had previously been indifferent to the geographical contributions of geologists, now began to give heed to them. Thus it was that Powell's and Gilbert's generalizations gaind the wide-spread acceptance that they richly deservd; yet helpful as they were, their incompleteness in certain respects deserves attention, in order again to emphasize the historical fact that not only is progress in geography, as in other subjects, accomplisht by successiv forward steps, now in one direction, now in another, rather than by a uniform forward movement of the whole body of the subject, but also that the successiv forward steps were in many cases incomplete strides. Thus Powell's conception of the baselevel of erosion did not pertain so much to the level base with respect to which subaerial erosion is performd, but rather to a delicately warpt imaginary surface passing thru all the stream lines of a worn-down land area, and therefor permissibly standing well above ocean level, especially in the upper reaches of a large river system like that of the Mississippi, even tho somewhat underlying the visible surface of degradation. It is, I believe, not so much to Powell as to Gilbert that we owe the generally accepted idea of baselevel as a level base; in general, the extension of the ocean or geoid surface under the continents.

Powell's Classification of Rivers. — Again, Powell's three-fold classification of rivers as consequent, antecedent and superimposed was incomplete in two respects that must excite surprise when they are recognized; it omitted the important class of subsequent rivers which are developt by retrogressiv or headward erosion along weak structures,

and of which Powell himself had seen typical tho small examples behind the piedmont monoclinal ridges on the northern flanks of the Uinta Mountains; and it omitted also the very significant tho less important class of obsequent rivers, which take the place of consequents in so far as the latter are shortend at their heads by the recession of cliffs; and this omission is even more singular than the other, because the recession of cliffs was a subject to which Powell gave especial attention in his account of the plateaus of southern Utah and northern Arizona, where he must repeatedly have seen streams which, like Kanab creek, flow against the gentle dip of the strata that they cross and which have manifestly increast in length as the cliffs away from which they flow have retreated. The first of these omissions would not have occurrd had Powell been traind in the modern fashion of "looking up the literature of his subject," but there is little indication that, overwhelmd with the flood of new facts and ideas during the exploration of a wonder-land, he ever spent his time in searching for accounts of similar facts or for the earlier publication of similar ideas in older lands. Had he done so — but as one of his ardent admirers I feel no regret that he did not — he would have found that a clear account of subsequent rivers, as they are now calld, had been publisht by Jukes in 1862.[12]

Let it be here noted that the chief geographical value of such terms as consequent, subsequent and obsequent in the description of streams and their valleys does not lie in the indication that they give as to the manner in which the streams were originally located and the valleys were excavated; but in the indication that they give of the present and visible features of the valleys. Thus a consequent valley usually has similar features opposite each other, right and left; and in following such a valley down-stream, the outcrop scarp of the ridges that it transects face up-valley, and the back slopes slant down-valley. An obsequent valley is also usually symmetrical, right and left, but here the transected ridge-scarps face down-valley and the back slopes slant up-valley. A subsequent valley, on the other hand, usually has unlike rocks, forms and soils on its two sides; and it is commonly the case that subsequent valleys join the consequent valley to which they are tributary in pairs, one coming from one direction, the other from the opposit direction. Antecedent and superposed valleys also have peculiar characteristics today, as well as peculiar origins. It is therefore their present-day descriptiv value that recommends these terms to the geographer.

[12] J. B. Jukes. On the mode of formation of some of the river valleys in the south of Ireland. Quart. Journ. Geol. Soc. xviii, 1862, 378-403.

Perhaps a still more significant illustration of the lack of finality in a step of progress is to be found in Powell's attribution of Green River to his antecedent class in its deep-cut course thru the Uinta Mountains. True, this explanation gaind wide-spread acceptance; indeed, the principle therein involvd was thought to be as novel and ingenious as it was demonstrabl and illuminating. Ingenious and illuminating the principle certainly was, but it was not altogether novel, for to say nothing of earlier suggestions to the same effect in Europe, Hayden had previously but inconspicuously announced the same idea regarding the course of the Missouri thru the gate of the mountains in Montana;[13] and the antecedent origin of the Green was by no means demonstrabl, for good reasons may be given to show that it owes its path less to antecedence than to superposition. Nevertheless, Powell's general idea that a river may keep its antecedent course in spite of the uplift of a mountain range athwart it still holds good as a general principle, and even if it does not apply to Green River, it is believd to find application in the course of the Bighorn which twice cuts thru the curved mountain range of the same name on entering and leaving a well enclosed intermont basin; and also in the course of the Meuse thru the Ardennes. Powell's special merit in the case was that he not only expounded the idea of antecedence with captivating vividness, but that he also — and this is of about equal importance — gave the idea an appropriate name. It may be briefly added that his terms, cataclinal, anaclinal and the rest of the -clinal set, which he invented to indicate merely an observd relation between streams and structures, have been less generally used than his other terms, consequent, antecedent and superimposed, which give inferd explanation to the observd relation: and this may be taken to show that an explanatory terminology has come to be generally preferd to an empirical one.

Gilbert's Treatment of the Basin Ranges. — Very much as Powell gaind deservd renown for his explanation of antecedent rivers, even tho the example which he took as a type is probably not antecedent, so Gilbert gaind deservd renown for his scheme of fault-block mountains, even tho the scheme and its application to the Basin ranges were both far from being completely stated in his famous report of 1873. Of his most significant omissions, one concernd the form that the land surface possest before it was faulted, and the other concernd the changes produced in the faulted blocks during and after faulting. Singularly enough, Powell was the first to make explicit statement concerning the pre-faulting land surface, to the effect that it had been

[13] Sixth Ann. Rept. U. S. Geol. Survey, Territories, 1873, 85; see also an earlier statement of Hayden's, Amer. Journ. Sci., xxxiii, 1862, 68-79.

worn down to low relief; how he reacht this important conclusion is not recorded, for he had not had extended experience among the Basin ranges: it seems like a case of scientific intuition or inspiration! Gilbert made no mention of it even in his later accounts of the ranges, but he recognized the truth of it during his field work in 1901, when he saw that certain ranges have gently inclined upland profiles independent of their deformd structures, and when he also detected evidence of intermittent faulting and of much erosion during faulting; but the results of that season in the field were not publisht. Yet incomplete as his original explanation of the Basin ranges was, it sufficed to introduce a new concept concerning mountains, and the concept was later shown to be correct by Louderback's study of the Humboldt ranges, and by other special investigations. If it be remarkt that the concept is geological rather than geographical, it may be answerd that, while it certainly pertains to geology, it is by no means foreign to geography, but quite as pertinent to it as the concept of the formation of volcanoes by eruption; and surely even the most humanized geographer can hardly exclude that traditionally geographical idea from among his responsibilities. It may seem like quibbling to point out that so notable an investigator as Gilbert did not do everything altho he did much; but the real object of this paragraph is again to show that progress is not finality, and thus to encourage geographers to believe that even today, half a century after Gilbert's brilliant achievments in physiography, abundant opportunity for still further achievments remains in spite of the advance made in that interval.

Gilbert's discussion of land sculpture in his Henry Mountains report is still in many respects a standard for study, especially with regard to the transportation of detritus by streams: his continuation of the same study by elaborate experimental investigation in California 30 years later did not advance the geographical phases of the subject greatly, in spite of the detaild analysis that he then gave to it; but it is a pleasure to note that the latest of his Survey reports [14] — a report that appears to be much less known that it should be — includes a truly remarkable application of his early announced principles to the quantitativ description of recent, river-made detrital plains in California, and that to this he adds a most ingenious consideration of the far-reaching tho small effect of the seaward transportation of detritus in causing a change in the position of the submarine bar outside of the Golden Gate.

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[14] Hydraulic Mining Débris in the Sierra Nevada. U. S. Geol. Surv., Prof. Paper, 105, 1917.

Geographical Contributions of the United States Geological Survey. — It is very natural that the members of a geological survey, whose first duty may be the investigation of underground rock structures, should in the course of their field work gain a close knowledge of the surface forms which the rock structures underlie, and it is equally natural that their reports upon the strictly geological problems of the under rocks should frequently include descriptions of their surface, which if not exclusivly a geographical matter is at least as geographical as it is geological. Hence, just as the many state-survey reports of early date frequently containd pages or chapters on topography, treated as well as the condition of earth science then made possible, so the numerous reports and bulletins of the national Geological Survey contain a great body of physiographic information treated in view of the modern development of earth science; that is, in a thoro-going explanatory manner. Much information of this kind is now as indispensabl geographically as it is authentic physiographically. What American geographer has not profited, and profited greatly, from his study of Gilbert's monograph on Lake Bonneville and Russell's on Lake Lahontan, in which the terraced slopes of the Basin ranges are so finely described; who has not felt a rising glow of enthusiasm as he read Dutton's report on the High Plateaus of Utah, and later his monograph on the Colorado canyon; has any one who learnd the lobate arrangement of our terminal moraines, first locally detected by Gilbert in northern Ohio, later more broadly described by Chamberlin, and afterwards elaborated by Leverett and others, faild to class those previously unrecognized features as elements of our geography, indeed, as elements quite as pertinent to the low-relief geography of the plains and prairies adjacent to the Great Lakes as the open valley of the middle Rhine and the gorge below it are to the stronger-relief geography of central Europe! An so it is with McGee's edifying account of the southern Coastal Plain, with Hayes and Campbell's geomorphological analysis of the Southern Appalachians, with Upham's monographic report on the Glacial Lake Agassiz, with Keith's illuminating account of the Catoctin belt in Virginia, with Hill's many studies of Texas, with Johnson's faithful portrayal of the High Plains of Colorado, with Matthes' vigorous investigation of the glacial cirques along the crest of the Big Horn mountains, and — to close this cycle in which various other reports might be included by returning again at its end to the authors named at its beginning — with Russell's lucid accounts of the lava plains of Oregon and with Gilbert's most readable, tho quantitativ story, above referd to, of the recently formd detrital plains in California.

It is not simply that, during the last decades of the nineteenth century, our geographers gaind new information by reading this unrivald series of reports, but that they were thereby convinced that the rational or explanatory treatment of land forms was far superior to the old-fashiond empirical treatment. Never again for them would an antiquated, empirical treatment be satisfying. Hence the little explanatory beginning made long before by Lewis Evans in his passing allusion to the strata of the Coastal Plain in New Jersey as marine deposits, the larger effort seen a century later in Guyot's valiant but unrealized intention of treating geographical features in view of their origin, and the brilliant tho localized success of Lesley's interpretation of the Pennsylvania Alleghenies as the surface presentment of their understructure, were followd toward the close of the nineteenth century by the whole-hearted acceptance of the responsibility that land forms must be explaind as well as described; and physical geography thereby became so enlivend and therefor so attractiv a subject that a good number of our younger geologists crost over the low partition that separated them from it, and made themselves as far as they could into geographers. This was by no means the time of the beginning of physical geography among us, for we have seen that excellent empirical descriptions of land forms were written over a century earlier, and that such descriptions have been on the whole improving ever since; but it was the time of the most active advance of physical geography from an empirical or half-hearted explanatory treatment into a would-be thoroly explanatory or evolutionary treatment.

One of the most significant signs of this advance was the increase in the number of well defined type forms, in terms of which the elements of a landscape might be described; and it thus became impossible any longer to hold the new physiographic wine in the narrow bottles provided by the old text books. From this time on, geography became more and more a subject for professional study, a subject to be developt for itself; and before many years it was even urged that, in order to impress more distinctly a purely geographical quality on geographical essays, the time-names of geological formations should be excluded from the accounts of under-structures as irrelevant or distracting; and also that the explanatory descriptions of land forms as produced by the action of external processes on structural masses should be stated, in so far as verbs are concernd, in the present tense, as a means of holding attention to visible existing features. Thus the effort of geographers to develop geography for itself markt a great step forward from the earlier time when the elements of geography were dealt with by others than geographers and as incidents in the treatment of

some other subject. The latter years of the nineteenth century therefore witnest the most rapid growth of scientific geography that we have experienced; and it was at about the same time that, as already told, the so-calld " causal notion " made its way into school geography, greatly to the advantage of teachers and pupils alike.

The Cycle of Erosion. — One of the consequences of the whole-hearted adoption of the idea that land forms may be explaind as well as described was the attempt, as above intimated, to give them an explanatory description; and an outcome of this attempt was the gradual development of the scheme of the cycle of erosion, under which a mental counterpart for every land form is developt in terms of its understructure, of the erosional process that has acted upon it, and of the stage reacht by such action stated in terms of the whole sequence of stages from the initiation of a cycle of erosion by upheaval or other deformation of an area of the earth's crust, to its close when the work of erosion has been completed: and the observd land form is then described not in terms of its directly visible features, but in terms of its inferd mental counterpart. The essence of the scheme is simple and easily understood; yet it is so elastic and so easily expanded and elaborated, that it can provide counterparts for land forms of the most complicated structure and the most involvd history. In its essence or outline it may be apprehended by the pupils of secondary schools; in its fuller development it calls for close attention by the disciplind expert.

One of the chief advantages of the scheme resides in the aid that it gives to the systematic extension of ideal type-forms in number and variety; and in this respect the contrast between the scheme of the erosion cycle and the much simpler scheme than Lesley employd for the Pennsylvanian Alleghanies should be pointed out. It is true that Lesley perceivd the possibility of working out ideal types in large number, for he wrote on that point in his " Manual of Coal and its Topography " as follows: " The science of topography, like every other science, proceeds to deduce from a few elementary laws an infinity of forms, by which these few laws may or actually do express themselves upon the surface of the earth. The possible is always an infinite series, the actual a limited or fortuitous selection from it." But in making application of this sound principle, his only variable factor was structure: he does not seem to have recognized that, besides the ordinary or normal erosional process of weather and streams, destructive changes may also be produced by weather and ice, weather and wind, weather and solution, and weather and waves, or at least he gave no detaild attention to these various processes; nor did he understand that time

is also an element of great importance as affecting the form produced by any given process acting on any given structure: for him, each structure had only one form. It is the great merit of the scheme of the erosion cycle that it strives to take account of many values of all the variable factors that can enter into it. The variety of type forms thus obtainabl is endless.

There can be no question that an explorer, who adds a mental equipment of ideal type forms thus developt to whatever physical equipment he provides for his travels, will thereby largely increase the completeness and the accuracy of his physiographic records. For example, the forms assumed by the waste of the land on the way to the sea are, under the scheme of the erosion cycle, treated, like the forms assumed by the waters of the land on their way to the sea, as essential features of the landscape, altho the first are as a rule slow creeping, while the second usually have a rapid flow. Hence the vast amount of information gatherd and publisht by the Bureau of Soils in the Department of Agriculture might be much more serviceable to the geographer, and perhaps to the agriculturist also, if it had been treated with fuller consideration of the cycle scheme.

Moreover, when properly applied in a direct explanatory description instead of in a roundabout argumentativ analysis, the scheme of the cycle saves physiography from the reproach of being only maskt geology, because it enables one to state the results reacht by explanatory analysis in terms of physiographic types, without going thru the argumentative demonstration that the analysis involves;[15] and it thus directs attention to the visible facts of present landscapes, instead of diverting attention to the invisible conditions and processes of past time.

One apparently unimportant device contributes helpfully to this evidently desirabl end: that is, as intimated in a preceding paragraph, the consistent use of verbs in the present tense; a device, the real value of which can be measured only by intentional and repeated experiment. This is a matter which deservs more attention than can be here allotted to it: it may, however, be noted that the section on Physiographic Geology in the text of the Folios issued by the U. S. Geological Survey very properly uses verbs in the past tense, because the object there is to review the past history of the quadrangle under consideration: the translation of the explanatory or evolutionary story there given into a present-tense explanatory description of existing forms, without argument, is a useful exercise for young geographers, who may thus ac-

[15] See a fuller discussion of this principle in:—Relation of geology to geography. Bull. Geol. Soc. Amer., xxiii, 1912, 93-124.

quire correct habits of treatment while they are still in training; such translation is useful also for older geographers, but for them it is as a rule so difficult an exercise that they can hardly be expected to become expert in it.

Mapping of the United States. — The survey of our public domain by the Land Office of the Interior Department, which was establisht in 1785 as a sort of national real-estate agency, had for its chief object the division of a vast territory into markt lots or "sections" of convenient area for disposal to settlers, rather than the preparation of a topographic map. Nevertheless a great number of natural features were thereby located, and the state maps, from Ohio and Florida westward, issued by the Land Office servd for many years — and so they still serve in those parts of the country not otherwise surveyd — as the basis for our maps in school and commercial atlases; but unhappily the popular use of these maps have given many Americans the idea that the relief of the land surface is generally an unimportant element, and needs to be represented only where it is of mountainous strength. Many of the Land Office surveyors unquestionably did laborious and faithful work in marking square-mile section corners with a fair approach to accuracy, the results of which are still to be seen in the rectangular, made-to-order road systems of many states; and this good work should not be overlookt because some of the surveying done by contract was so scandalously inaccurate as to become a subject of public ridicule.

The Coast Survey was establisht in 1807, but its field work was not begun until 1816. It adopted a high standard of accuracy in its work, to which it has always adhered; and necessarily so, because, unlike the rough outlining that sufficed for the Land Office maps, the correct representation of positions and depths and distances on its charts was a matter of life and death to the coast-wise navigator, and of safety or loss for vast amounts of property; indeed, its work was sometimes needlessly delicate, as in the engraving of an elaborately hachured map of Mt. Desert on the coast of Maine, publisht in 1875. But its coast charts as a whole, now covering all of our Atlantic, Gulf and Pacific coasts and extended into Alaska and the Philippines, are altogether admirable; they constitute a geographical accomplishment of which Americans may well be proud. Charts of late publication, on which the land is tinted, thereby gain a greatly increast legibility. The same may be said of the charts of the Great Lakes, constructed by or under the direction of the Army Engineers and of the maps of our greatest rivers as produced by the Mississippi and Missouri River

commissions. An immense amount of information is here presented in graphic form, of which no more striking illustration can be cited than that containd in a series of inch-to-a-mile maps of a stretch of the lower Mississippi, on which the surveys of about 1890 are printed in black, and the river outline as surveyd some ten years later is overprinted in red, thus exhibiting with great accuracy and in great detail the changes made by the river in a definit period.

Topographic Maps of the U. S. Geological Survey. — Great as are the contributions of the surveys above named, by far the greatest addition to the knowledge of our topography comes from the national Geological Survey, which, because it was charged with the preparation of a geological map, assumed under Powell's energetic direction the task of preparing a topographical map for geological coloring, the geodetic network for this map being provided by the Coast Survey, which therefor gaind the enlarged name, Coast and Geodetic Survey, to indicate its enlarged duties. Thus the Geological Survey proceeded to organize a corps of topographers, altho at first without explicit legislative authorization for so doing. The far-sighted reasons for the use of contours instead of hachures, as well as for other decisions regarding the method and style of mapping adopted in his comprehensive plan, were ably set forth by Powell in his testimony before a joint committee of Congress in 1885, and are recorded in a public document that merits reading by all who are interested in that phase of our geographical progress.

Altho the maps already publisht add greatly to our geographical knowledge, the sums allotted to topographic work for some years after that division of the Survey came to be officially recognized were so small that a long period would be required before the mapping of the whole country could be completed. True, progress has been accelerated where the cost of the work has been shared between the national and state governments, and several of the more enterprising states have thus already secured maps of their entire area; but even as thus accelerated the delay in completing the survey of the entire country would be too long. It is therefor now proposed, and geographers the country over may well support the proposal, to increase the appropriations for topographic work to such a sum as will complete the mapping in about ten years. Good warrant for supporting this proposal, large as its cost may be, is found in the great improvement in the accuracy of the maps in recent years as well as in their greatly increast use in many practical ways. It is unfortunately not to be denied that some of the maps first issued by the Survey were inexpressiv, not to say inaccurate, especially those which were prepared by the hazardously

unsound device of redrawing in contours the shaded or hachured maps of certain earlier surveys without a return to the ground. Indeed, even some of the actually surveyd quadrangles were so hurriedly done in the early years of the work, under the demand for large area in short time, that certain maps produced by one of the best topographers the Survey ever developt were seriously imperfect; and the geologists of the same Survey later found it impossible to identify actual topographic features on those maps as a means of locating geological boundaries; hence the quadrangles had to be resurveyd more deliberately.

Some excuse for this sort of work may have been found in the belief that a large visible product of one year was necessary in order to secure new appropriations from Congress for more mapping the next year; but that was not a policy which could endure and its era closed about 30 years ago. The maps produced since then are of a much higher order of accuracy; and much of their accuracy depends on the fact that the contour lines are as far as possible drawn on the plane-table sheets in the field. Some of the latest sheets to be issued by the Survey are delicately hand-shaded on a contourd base, and thus express the relief of the surface in a highly effective manner. It is interesting to note that shaded maps are also now in process of publication by the Army Engineers, but these are prepared by a mechanical process instead of being shaded by hand. The most apparent difference between the two is in the strength of shading; a more subtle difference is this: on the Survey maps, all slopes that face the source of illumination are light-colord from stream line to ridge crest; but on the Army maps, the shadow of a high ridge often falls on the basal slope of the next ridge, so that the line between shaded and non-shaded areas does not there coincide with the valley-bottom stream line.

Just as the Land Office years ago summarized its field records in state maps, the best of their kind at the time, so the Geological Survey is now generalizing the details of many large-scale sheets in state maps of smaller scale — Renshawes, they ought to be calld — in which contours are replaced by a very effective system of shading. The large amount of authentic information thus brought together is not less impressiv than the clearness with which it is presented. Even the best informd geographers will find, when they examin the "Renshawe" of an old-establisht state like New York, or of a newly establisht state like Wyoming, that they have much to learn. Thus the contourd maps, shaded maps and state maps are all to be regarded as among our formost steps of geographical progress. They now present us with a great fund, a vast flood of trustworthy information about our country, upon which all sorts of studies, geological, biological, technical

and historical, as well as geographical, may be based. The student of geography today, for whom topographic sheets are available, can hardly imagin, in the wealth of material before him, how extreme was the destitution of his predecessors half a century ago.

Nevertheless, in spite of the dictum of a president of the Royal Geographical Society a dozen years ago to the effect that geography is little more than surveying, maps of the earth no more constitute our science than charts of the stars constitute astronomy. Maps are, to be sure, indispensable as reduced and conventionalized representations of certain out-door facts, but they are inarticulate, and their silence seems to have affected their makers; for notwithstanding an intimate acquaintance with the areas they survey, topographers are as a class geographically taciturn. It is as if their expertness in the graphic expression of facts were accompanied by an atrophy of the faculty of verbal expression, following its disuse; they speak eloquently in lines, but they are with few exceptions mute in words. The fact is, they are busy all summer in mapping outdoors, and all winter in completing their maps indoors; they have no time to write, even tho they may have much to tell.

However, even if topographers are as a rule geographically silent, the maps that they produce are invaluable aids in the teaching of geographical speech to students, because they present so wonderful a variety of facts to speak about. Just as the weather maps make it possible for a high-school pupils to "discover" the movement of cyclonic areas and to explain the weather changes that they produce, so the topographic maps present to a student many facts concerning our country that were known only to explorers a generation or two ago: and just as the systematization of a subject such as climatology expedites its acquisition, so the possession of a laboratory collection of maps on large and intermediate scales, all available for use by qualified students, expedites the understanding of the topographic elements of regional geography. In this respect we are today in an epoch of remarkably rapid progress, for new maps on various scales are appearing in quick succession. When maps for all our states, like the invaluable "Renshawes" of New York and of Wyoming now in preparation in the work rooms of the Geological Survey, become available for use in schools and colleges, the teaching of regional geography will be greatly facilitated.

Descriptions of States. — One of the best indications of geographical progress in recent years is the publication of physiographic or geographic description of certain states. It is a curious commentary on our

civilization that really competent descriptions of that kind are still so generally lacking: but it is still true that, except for incomplete chapters in geological reports, the geography of most of our states is not yet publisht in a form consistent with the spirit of modern scientific geography. Vermont, North and South Carolina, Arkansas, Montana, California and many others are alike "unknown" in this respect. Hence all the greater credit should be given to the authors who, either with or without state aid, have prepared physiographic or geographic descriptions of their home areas on a more or less comprehensive plan. As examples of such descriptions, mention may be made of Marbut's "Physical Features of Missouri," 1896; Abbe's "Physiography of Maryland," 1899; Hill's "Physical Geography of the Texas region," 1900; Tarr's "Physical Geography of New York state," 1902; Tower's chapters on the "Physical Geography of Pennsylvania," 1906; Martin's "Physical Geography of Wisconsin," 1916; Visher's "Geography of South Dakota," 1918; and Malott's "Physiography of Indiana," 1922.

Important supplements to these texts will be found in the "Renshawes" of the various states, referd to above in the section on mapping; for as they are progressively publisht, they will show almost at a glance the true distribution of topographic features that would otherwise be difficult of acquisition. Both the texts and the state maps teach another lesson; namely, that a mature knowledge of regional geography must be built up by putting together, in their proper relations, a multitude of local details. As in book-keeping, where many items of dollars and cents must be added together before the true total of receipts and expenditures can be learnd, so the making of anything so truthfully expressiv as a state "Renshawe" requires the concentration of many large-scale maps, based on actual surveys, into a single map of a reduced scale; and similarly, acquaintance with the regional geography of a state calls for the orderly gathering of its many parts, each of which is no larger than a single landscape. It is for this reason that the way of sound and scientific geographical progress begins with a careful study of visible things; the contemplation of continents comes later.

Human Geography. — Before this page is reacht, the reader will probably have exclaimd: — Why is the human side of geography — that is, anthropogeography — so long neglected in this essay, while the physiographic side is treated in so much detail? The answer to the exclamation may be in part: Because the essay is written by a teacher whose work has been largely on the physiographic side of the science; but the answer must also be, and in greater part: Because the advance made in human geography did not begin so early and is not yet

so great as that made in physiography. If plant and animal geography are associated with human geography under a general term such as ontography, or the organic side of geography, in contrast to physiography or the inorganic side of geography, the small progress made in ontography as compared to the greater progress accomplisht in physiography becomes all the more striking.

A brief review of this aspect of our subject will be profitable. During the seventeenth and eighteenth centuries the records of colonization along the Atlantic seaboard contain innumerable instances of human responses to physiographic environment — even the definition of colonial units which later became states was largely influenced by features of the shore line — but instead of being then recognized as such they were simply recorded, naturally enough at that time, as so many unrelated items of occurrence, usually with more detail on the human than on the physiographic side, and thus they awaited later embodiment either in history, where they have been much used, or in geography where they have been less used. Again during the first half of the nineteenth century, reports on western exploration as a rule containd more material pertaining to human geography than to physiography, for their pages hold many accounts of the manner of living on the land adopted by Indian tribes as well as by early settlers, in contrast to but few and very imperfect descriptions of the land itself. But all these accounts of Indians and settlers are hardly more than so much raw material, which may be used in weaving either a geographical or a historical fabric, according to the relations into which the material enters. In their original form, however, the accounts rarely make the attempt to develop relationships; they are like felld timber, which might be sawd into lumber or ground into pulp, but which was not used in either way.

Then came Guyot's effort to correlate earth and man. As we have seen, he attempted to treat problems of continental breadth under a teleological philosophy; and perhaps because he did not attack problems of less magnitude, dealing with local human responses to physiographic environments of more limited area, and still more because his effort was made in a pre-evolutionary era, his teaching had comparatively little effect in introducing the "causal notion" until several decades after his book was publisht.

During the latter part of the nineteenth century the difference in the rate of advance of physiography and of ontography was very great; so great, indeed, that some then thought physiography was over-developt; and this was perhaps true from an educational point of view, particularly with regard to certain secondary schools, where the teach-

ing of physical geography to the exclusion of human geography was regrettable; but from the point of view of scientific geography, a better judgment would have been that, in spite of the emphasis that Guyot had given to it, human geography remaind under-developt. No series of essays touching that side of geography had then appeard which can for a moment rank with the series of Geological Survey reports above cited as touching the physiography of the lands; nor indeed had any studies of human reactions to climatic influences nearly utilized the abundant information then available in the reports of the National Weather Service and elsewhere.

It was not until near or after the close of the nineteenth century that the study of human geography was taken up among us more intentionally and more seriously. It was then carried forward by helpful impulses from three very unlike sources: first, those coming from studies of Indian tribes by American ethnologists; second, those imported by American students from universities in Europe; third, those developt from studies of the geographical factor of industries and commerce by American economists. Nothing will be here said of what is commonly calld historical geography, because nearly all studies under that title are better clast with history.

Contributions from American Ethnology.—No one essay better illustrates the aid that human geography may receive from ethnology than Fewkes' study of the religious ceremonials of an Indian tribe.[16] There one may learn how the Hopi, whose village was placed on the top of a small mesa in the great American desert, were so constraind by the topographic limitations of their home and so influenced by its aridity that even their religious observances and the calendar by which the observances were dated had a physiographic basis. For example, their little cornfields on patches of the least arid soil below the mesa were planted after prayers to the rain god, because rain falling from the cumulus clouds of thunderstorms was their greatest good; and the date of planting was the day when the northward shifting of the rising sun, as seen from their village, reacht a certain point on the distant, treeless horizon.

It is just as appropriate for a geographer to utilize the anthropogeographical elements of this most edifying ethnological story as for him to utilize physiographic elements found in any of the Geological Survey reports above cited; for in both cases he may be assured that the authors of essays in subjects so intimately associated with the existing surface of the lands have themselves already borrowd abundantly

[16] J. W. Fewkes, The Tusuyan ritual. Smithsonian Report for 1895, Washington, 1896, 683, 700.

from geography. Indeed, nothing is more proper than this interplay of common elements in associated sciences; for it is the relation into which the elements enter rather than any inherent quality of the elements themselves which determines the science with which they may be here or there associated. The rocky home of the Hopi enters into geology, for both the deposition of the rocks and their erosion into their present form are processes of past time; the climate of their home can only be understood in view of the general circulation of the atmosphere, which is a large problem of geophysics; the flora and fauna of the surrounding desert belong, if studied as including so many plants and animals, under botany and zoology; the Hopi tribe, as occupants of the region, deserve at least a brief consideration under the history of the western United States; the cultivation of their scanty crops, dependent on both soil and climate, merits mention in an account of primitive agriculture, just as their tribal organization, largely affected by their isolated life on a residual mesa, should be considerd in discussions of primitive government; the manner in which they propitiate their gods, largely a consequence of their climate, must surely be taken into account in a story of the evolution of religions. Finally, elements of all these varied aspects of the Hopi in their desert home enter, each according to its kind, into systematic geography; and all such elements, combined in their actual grouping, enter into a regional description of their part of the world.

Another suggestiv contribution to geography coming from American ethnology is found in McGee's study of the Seri Indians on the arid Mexican coast of the Gulf of California,[17] this contribution being of special value because of the author's traind expertness in physiography as well as in ethnology. His description of Seriland in its physiographic aspects alone is admirable; and his study of the many ways in which physiographic factors have influenced the human inhabitants of the region is most interesting and instructiv. One of the most manifest influences is that by reason of the dry climate, the open surface, the small food supply and the scanty poplation, the Seri have become exceptionally fleet and enduring as runners; they can capture deer by pursuing them on foot and exhausting them; one of the tribe overtook a running horse, leapt upon him, seized his jaw and threw him so as to break his neck.

European Influence on Human Geography in America.—Under no heading more properly than under this one can the relativly small

[17] W. J. McGee. The Seri Indians. 17th Ann. Rep. Bureau Amer. Ethnology, Washington, 1898, 1-344. See also his Papagueria, Nat. Geogr. Mag. ix, 1898, 346-371; and McGee and Johnson's Seriland, Nat. Geogr. Mag., vii, 1896, 125-133.

measure of European influence on the development of geography in America be alluded to. The physiography of the lands as now treated among us is largely an American product. American studies of meteorology and climate are of creditable originality and magnitude, but here the world-wide influence of Hann of Vienna is significant. It will later appear that certain important aspects of phyto and of zoogeography are largely the outgrowth of American studies. It is in human geography that we owe the most to European teaching; first, as already told, to Guyot; later and in larger degree to Ratzel, whose views on anthropogeography, altho represented in America chiefly by a single one of his pupils, have had great influence among us; later still, but as yet in less degree, to the French school of historical geographers of which Vidal de la Blache was the leading exponent.

It should be recognized that many illustrations of the influence of geographic environment on human conditions adduced by Ratzel and Vidal de la Blache are not taken from observations of the visible present, but from records of the historic past, of which Europe has so great a store. It is therefore natural that the historical treatment of geography brought to America from European sources should attain much prominence; but the historical element is often so dominant that a large part of these studies might be better regarded as the geographical basis of history than as the historical aspect of geography; and it is perhaps because of a commendable wish on the part of American anthropogeographers to make the geographical basis of history easily understood, and thus to persuade historians that such a basis would provide a sound foundation for certain of their studies, that American essays on historical geography usually avoid a matured and technical treatment of the land forms which provide the physiographic stage on which the historical drama has been playd, and of the climate which so strongly colors the scenery, while adopting a fully matured treatment of the drama itself. It is as if some of our anthropogeographers felt a greater interest in developing geography for historians than for geographers. There can be no question that such an effort will be helpful in the historical field to which it is directed; nor can there be any question that an effort of equal expertness and intensity would be helpful in the geographical field within which it originates: hence one must hope that among the disciples of this school, many shall be geographers who will draw all manner of illustrations from human history for the enrichment of human geography, while others may be historians who will introduce a firm geographical foundation for their studies of humanity.

There is happily evidence already at hand that this consummation, so devoutly to be wisht on the geographical side at least, is in the way of being realized. There are studies of certain states or regions in which the effort is made to treat the inorganic or physiographic aspects of geography as thoroly as the organic or ontographic side; Visher's "Geography of South Dakota," 1918, Sauer's "Geography of the Ozark highland in Missouri," 1920, Ridgley's "Illinois," 1921, Peattie's "Ohio," 1923, and Smith and Walker's "Texas," 1923, deserve mention as advances in this direction. But there is also evidence that geography, as conceivd by some of our geographers, has been humanized to such an extent that its physiographic side is reduced to a minimum, the analytical study of land forms being relegated to geology. These geographers may go so far as to declare that a region without human inhabitants is not a proper subject for geographical study; and may thus exclude Arctic and Antarctic explorers from the category of geographers, in spite of the unanimity with which they are regarded as geographically eminent by all geographical societies, whose gold medals might almost go begging but for these worthy recipients of such honors, and whose action in thus conferring the medals will be condemnd only by the extreme humanists as giving geography too much latitude.

It is in the extremely humanized conception of geography that we find the most complete contrast to the conception of geography as little more than surveying, above alluded to as formulated by a recent president of the Royal Geographical Society. But the extreme humanistic view is probably not any more generally accepted in America than its opposit is in Great Britain; it is more unbalanced on the human side than the view which some American geographers are thought to hold is on the inorganic side, to the effect that the dominant element of geography is physiography, which needs to be flavord only a little with the human element for its completion. Thus our progress has led to the apparent existence of two schools, each of which thinks that the other gives too much consideration to a favorite factor. Those who cultivate chiefly the human side of the subject, believe that physiography as they conceive it is too geological to be retaind; those who cultivate chiefly the physiographic side believe that human geography as they have encounterd it goes too far into history and economics. Every freedom should of course be given to the development of individual views; but for the benefit of geographical science as a whole, it would seem that the next step of progress should include a meeting of these two extremes for the purpose of discussion, with the wish of reaching a better understanding of each other's views, and perhaps

even in the hope of at least lessening their differences, if not of approaching an agreement.

The possibility of reaching such an agreement may be materially increast if two preparatory steps are taken. One is a step recommended to physiographers to the effect that they should separate the analytical investigation of land forms, which ought to be regarded as a phase of geology, from the non-argumentativ statement of the results reacht, which must be accepted as good geography. The other is that economic and historical geographers should indicate more clearly than they usually do the essentially geographical phases of their studies, and set aside the other phases as belonging as clearly to economics and history as the analytical investigation of land forms belongs to geology. But if an agreement between the two schools is thus reacht, it is to be hoped that it will not discourage physiographers from making excursions into the domain of geology when they come upon a land form which needs analysis, and that it will not discourage excursions by economic and historical geographers into the domains of economics and history whenever the need of making such excursions is felt; for it is not likely that what geographers want from geology, economics or history will be furnisht to them in the form that they want it by the cultivators of those domains.

Economic and Commercial Geography. — The chief impulse toward the higher study of economic and commercial aspects of geography in America appears to have come, about 1900, from the Wharton School of Finance and Commerce, in the University of Pennsylvania. It is appropriate to add at once that by far the greatest exhibition of the material basis for the study of industrial aspects of geography is to be found in the near-by but independent Philadelphia Commercial Museum, which furnishes an unrivald opportunity for home studies of foreign products. Geography, thus practically concernd with problems of business and trade, gives special consideration to useful materials of all kinds, from the ore deposits in the earth, to the crops of the fields and the fish of the oceans, and treats their occurrence as natural resources, their production by cultivation or otherwise, and their distribution as raw materials or as manufactured products in trade and commerce, as well as the distribution of population as affected by all these factors.

A subject that might otherwise have been chiefly statistical is given a geographical flavor by a continued emphasis on locality of occurrence, on supply and demand as affected by climate and population, on manufacture as affected by sources of power and other factors, and on routes of transportation over land or across the sea. The arbitrary statement of the particular line of manufacture for which a town is dis-

tinguisht and the traditional list of leading products of a state, formerly announced without explanatory correlation in school text books, was given new and enlarged interest when correlation was introduced. Invaluable sources of information on such matters are found in census reports and in statistics of production, exports and imports, publisht by certain Bureaus of the Department of Commerce, and in the atlases publisht by the Bureau of Agricultural Economics. While these sources do not have so immediate a geographical quality as is apparent on the topographical maps issued by the Geological Survey of the Interior Department, the large geographical value that they do have will be more and more profitably extracted as the study of economic and commercial geography advances. Indeed, geographers who are concernd with these aspects of their science believe with good reason that what they take with advantage from economics may be balanced by what economists will take from geography, when they have come to understand how greatly their studies may profit by such taking.

The study of economic geography was welcomed because it brought out a utilitarian application of geography to life, and thus warranted the expenditure of time upon it in schools and colleges. It is unquestionably a phase of geography that calls for serious attention in the conduct of business enterprises, either of local or of international scope. But as in the case of human geography, there is no series of governmental reports and essays in economic geography that can for a moment compare with those of the Geological Survey in the domain of physical geography. There have been, as above intimated, census reports and statistical tables of one kind or another, of great value in economic geography, publisht by the government for over a century; but these are all about as taciturn as topographical maps; their content must be put into words and given proper treatment before it can gain a geographical quality and provide a geographical disciplin.

A characteristic of the present condition of economic and commercial geography is that, as is also true in the usual treatment of human geography, it makes small demand on a knowledge of physical geography. Indeed, in these several phases of geography, the forms of the lands are often treated in a very brief, not to say elementary and empirical manner, while the historical, economic or commercial aspects of man's activities are treated in much greater detail; and one is therefor led to question whether the problems thus developt do not belong more truly on the geographical side of history or of economics rather than on the historical or economic side of geography. Indeed, it sometimes seems as if even certain economic geographers thought their material was as immediately adaptable to economics as it was to geog-

raphy, and that it was therefor not distinguisht by any characteristically geographical quality. But surely these two subjects, altho closely related along their sides of contact, are not, if properly developt, so much alike that their statements are interchangeable: they may deal with the same group of facts, but the manner of dealing with the facts should be different if the two subjects deserve recognition as different departments of university study. On the other hand, it may well be that in the indifference of many historians and economists to the geographical aspects of their subjects, certain problems really belonging to them have been left to be treated by geographers; but it does not follow from this rather accidental distribution of responsibilities that such problems should be transferd from the study with which they are most closely associated and adopted by another.

It must of course be recognized that history and economics have abundant relations with geography, even if those relations have not been clearly enough brought forward by historians and economists; and furthermore it must not be assumed that there is any sharp line of demarcation between the geographical elements of history or economics and the historical or economic elements of geography. Nevertheless, if geographers are right in urging that their subject is cernd with so large and so peculiar a body of knowledge that, as above implied, it deserves recognition as an independent department of university investigation and teaching, it behoves them to cultivate and develop that body of knowledge so that it shall be characterized by a mental disciplin of its own, instead of borrowing its disciplin from other near-by subjects. There are promising indications that precisely such a disciplin is in process of cultivation in economic geography, especially by such out-doors students of the subject as are persistently tying economic factors to the ground after critically analysing the ground to which they tie them. This aspect of geographical progress is further considerd below.

The Biological Side of Geography. — It has long been habitual to devote certain chapters of text books on physical geography to the distribution of plants and animals; but so long as these chapters give little more than lists of the plant and animal occupants of a region or of a continent, they would have better place in the geographical chapters of botany and zoology than in the biological chapters of geography. The same principle holds true for certain would-be geographical essays or treatises, in which the account of the flora and fauna of a region gives little more than their scientific names. A great advance is made from that form of presentation when, instead of accepting Herbertson's definition of geography as the science of distribution, guidance

is found in Hettner's definition of geography as the description of the material filling of terrestrial spaces; and a still greater advance is made when, under this definition, all the constituents and occupants of a region, inorganic and organic, are not only described in their actual combination or intermixture, but when they are all shown to be in a greater or less degree interdependent, as conditiond by the forms and the climates of a region and by one another; in other words, when the plant and animal inhabitants of a region are treated in accordance with the principles of ecology, a new branch of science in which organic and inorganic elements are well blended, and to which a biological or a geographical quality may be determind rather by the object and order than by the content of presentation. Thus the regional treatment of plants and animals may acquire a truly geographical disciplin, which distinguishes it from the distributional treatment proper to the geographical chapters of botany and zoology.

The geographical disciplin of this aspect of our science may be still further strengthend in various ways: first, in so far as plants are concernd, by treating them as constituting natural associations or "formations," by which the visible appearance of the landscape is characterized, and for which appropriate geographical names may be given, instead of by treating the various species of plants separately under their technical botanical names; and this device is being rapidly developt by our ecologists. Again, it may be strengthend by treating animals as contributions to the visible—and one may add, to the audible—landscape; for example, the white dots made by mountain goats on unscalable cirque-head cliffs, the wheeling flight of the turkey buzzard high in the sky over our Southern States, the innumerable termite hills in certain treeless areas of South Africa, the clattering flight of locust swarms in Turkestan, the irregular paths made by bands of wild horses on the sage-brush plains of the Great American desert, converging and uniting toward springs or water-pockets, and the narrower yet very visible paths made by foraging ants converging toward their subterranean nests on the scantily grast pampas of Argentina. In all such examples, the precise species of the animal concernd is geographically of secondary importance, however essential it may be zoologically. Finally, just as the forms of a landscape should be treated in explanatory fashion in view of their origin with respect to cycles of erosion, because that fashion of treatment enables the writer to describe them most effectivly and the reader to visualize them most vividly, so the plant and animal constituents of landscape should be treated in an explanatory manner in view of their origin or migrational movements with respect to cycles of erosion, because that manner of treatment

gives the fullest appreciation of their occurrence as landscape constituents.

This view of the problem may be considerd transcendental by some; but it includes considerations of such fundamental importance that it must not be neglected by future geographers. Its first statement by Woodworth in 1894 [18] showd in a highly original manner the possibility of extending the scheme of the cycle of erosion into the biological field. Its value with respect to plant formations, along with a historical review of the gradual introduction of the idea involvd, was ably presented by Cowles in his address as president of the Association of American Geographers, in 1911,[19] an address of such importance that it alone justified the forming of that organization; for the speaker then made it clear that the description of the flora of a region from this point of view is not only practicable but illuminating. There can be little question that the line of geographical progress thus indicated will be followd in the future. No correspondingly thoro statement for animal life has been made, but a fine application of the principles there involvd is found in Chapman's statement that the condor, which is commonly associated with the Andes, was originally a bird of the pampas in southern mid-temperate latitudes, and that the extension of its habitat northward along the Andes resulted from the geologically recent upheaval of that already once-worn-down mountain belt, whereby a stretch of temperate climate enterd the torrid zone at high levels.

A simple application of this principle has long been familiar in the study of island life, and a modified application is well establisht in connection with episodes of climatic change, such as the Glacial and Interglacial epochs of the Glacial period, which are completed very much more rapidly than cycles of erosion. The occurrence of high-latitude lowland species of plants and animals on low-latitude mountain summits is a familiar case in point. When the organic inhabitants of a region are envisaged as the present actors in a terrestrial drama, who have come upon the stage as soon as the slow and long continued changes in its landscape scenery and in its climatic setting permitted them to take their place in succession to a long series of earlier actors, one of the largest conceptions that geography has yet reacht will have been gaind. Clearly, the practical application of this broad geographical principle lies in the future, for the mere recognition of the principle is one of the latest advances in geographical progress.

[18] J. B. Woodworth. The relation between baselevelling and organic evolution. Amer. Geol., xiv, 1894, 209-235.

[19] H. B. Cowles. The causes of vegetational cycles. Ann. Assoc. Amer. Geogrs., i, 1911, 3-20. See also: The physiographic ecology of Chicago and vicinity. . . . Botan. Gazette, xxxi, 1901, 73-108, 145-182.

An Analogy with Astronomy. — In the last 30 years the progress of geography has been so great that it has now come to be respected as a college study, and departments of geography, either independent as they should be or associated with some other subject as they have sometimes had to be while in process of establishment, have been organized in many of our universities. The students annually registerd as taking geographical courses in certain institutions are counted by hundreds. Let us therefore next consider what this science has come to be, now that it is growing so lustily. To make this part of my address clear, it is desirable to illustrate it by an analogy, both of likeness and of contrast.

The science of astronomy is cultivated by many of our ablest investigators, who have succeeded marvellously in securing the material equipment necessary for their studies, and who are all banded together in a strong and well organized society of national breadth. The advancement of their science is felt as their chief concern in their year's work as well as at their meetings, for in both their attention is focust on their main responsibility, which is nothing less than to learn everything learnable about the heavenly bodies; in short, to solve the problem of the universe. This vast subject has a descriptiv aspect, for every star must be examind as to its constitution and behavior; it has also a regional aspect, for it is concernd with the distribution of stars and nebulae in space; it has furthermore a historical aspect, for the evolution of stars with the passage of time is one of its leading problems.

How has this noble science gaind its eminent position? Not by the use of principles and methods that belong to it alone, but by the application of principles which belong under the universal sciences of mathematics, physics, and chemistry. It is true that some astronomers devote most of their time to observation, as in the search of asteroids, comets, double stars and nebulae, while others devote most of their time to investigations of planets and stars by mathematical or physical methods; yet however closely one of the latter group may apply himself to the mathematical calculation of planetary orbits he is nevertheless rated as an astronomer; however closely another of the same group may study the spectra of stars by purely physical methods, he is also rated as an astronomer; and if in the future, organic inhabitants of the moon or Mars are discoverd and studied by methods now undremt of, their investigators will still be clast as astronomers, not as biologists. Furthermore, while all the astronomy known to the ancients could be masterd by one man, the vastly extended astronomy of the present time is too great for one man's acquisition; hence astronomers must now specialize, just as mathematicians, physicists and chem-

ists, botanists, zoologists and anthropologists, historians, philologists and philosophers now do: yet the total content of the expanded body of celestial knowledge thus separately studied by specialists is still comprehended in the single science of astronomy.

How does a subject so greatly expanded and so definitly specialized as astronomy preserve its unity as a single science? Evidently, by the exclusiv pursuit of its limited, tho vast object, and by the assiduous cultivation of a mental disciplin best suited for the attainment of that object. The success of the science in this respect is unquestiond. Its methods of investigation are, as above noted, nothing more than special or local applications of universal principles and devices which, as such, are properly clast under other sciences; nevertheless, when applied to the study of the heavenly bodies, the applications of the principles as well as the results gaind by them are clast under astronomy. With these points in mind, astronomy and geography may be compared.

The comparison discloses certain likenesses. Like astronomy, geography is a localized science; much more localized, indeed, than astronomy, for it has to do with a single body, the earth; but altho so narrowly limited, the one body that it studies, being seen near at hand, discloses a variety of phenomena comparable to that of the heavens. Like astronomers, geographers may make use of general principles or of special devices that pertain to other sciences whenever such principles or devices are helpful. It matters not how logically such principles and devices, considerd by themselves, can be classified elsewhere; they may be used, whenever desired, in geographical research, and the investigator thus using them will remain a geographer.

But the comparison also reveals certain contrasts. Astronomy has the heavenly field all to itself; and it studies the past history of the heavenly bodies as well as their present condition. Geography has to share the study of the earth and its inhabitants with various other sciences; it includes only the present condition of the earth and leaves the past history to geology; it includes only the present condition of the earth's inhabitants and leaves the study of their past to archaeology; and it leaves also the more individual study of organized beings to botany, zoology, physiology, while the study of human groups in governmental relations is left to history; and so on. Astronomy is moreover pursued without the least regard to its utilitarian application and with very little regard to its educational relation; how remote from all "usefulness" are the positions of optically invisible stars and the periods of spectroscopic binaries, and yet how eagerly is research pursued regarding those utterly unusable items of creation! Geography might also be pursued without regard to its utilitarian or educational appli-

cation; but as a matter of fact it is actually pursued very largely with regard to the possibility of its being taught to immature minds, and in such a way that it shall be " useful " when those minds become more mature. Indeed, while astronomy is practically untaught in our schools and is little taught in our colleges, geography is universally taught in our schools; hence the greatest number of mature persons who have to do with it are occupied with the introduction of ready-made abstracts of the most elementary part of its content into the minds of children; and even when geography is taught in colleges, its more scientific aspects are as a rule rather hurriedly past over in order that its utilitarian or economic aspects may be the sooner reacht. Surely, no one would desire to see less geography taught in school; it ought to be taught more and better: no one would wish to lessen the attention given to economic geography in college, altho he might wish to strengthen the teaching of other aspects of the science and to encourage geographical research for its own sake. The contrasts thus found between geography and astronomy are continued when the annual meetings of their two professional societies are compared. Most of the astronomers there gatherd have little or nothing to do with teaching; their time between meetings is largely devoted to research, the results of which they then present to their colleagues without the least regard to utilitarian or educational possibilities. But most of the geographers gatherd at their annual meetings are teachers, whose time since the last gathering has been given largely to class work and whose communications are very commonly shaped with regard to the possibility of their being used in class work before the next gathering. Here again no one should wish to lessen the care with which geographical problems are prepared for school and college students; but some may wish to see a greater share of attention given to the cultivation of the uppermost branches of the science, without the least regard to its utility. The example of astronomers in this respect should be followd.

Geographical Disciplin. — It is not only with regard to their content that astronomy and geography are unlike, but quite as much with regard to the establisht definition of one science and the disputed definition of the other. As above pointed out, astronomy holds practically undisputed possession of the heavens, while geography seems to be a disputant with several sciences for its proper share of the earth; and even among geographers themselves, the great progress thus far made appears to have led, as already noted, to a disagreement instead of to an agreement as to what share or what view of the earth they shall claim as their own. Further progress in that respect can be reacht

only thru discussion; and it is as a contribution to such discussion that this section is written.

It must be seen in the first place that it is not so much the thing that is studied as the relation in which it is studied that is of importance in the classification of the sciences. If the sandstones of a certain ridge are examind as to their specific gravity, such study pertains to physics; if examined as to their chemical or mineral composition, their study pertains to chemistry or mineralogy; as to their nature as rocks, to lithology; as to their place in the earth's past history, to geology; as to their share in the visible landscape, to geography; as to their value as building materials, to engineering. If the inhabitants of a certain village or island are investigated with respect to their racial characteristics, such investigation comes under ethnology; if with respect to the chronological sequence of their activities thru the centuries, the study comes under history; if with respect to the form of their political organization, of their ideas as to right and wrong, or of their theological beliefs, the study comes under the science of government, of ethics, or of religion; if with respect to the place that they may take in the landscape, including the activities they manifest because of its surface features and its climate, the study comes under geography.

It must be seen in the second place, that it is not so much the method by which a thing is studied, as the object to be gaind that determins the classification of the sciences. The application of the physics of gases in meteorology, of analytical chemistry and of optical physics in mineralogy, and of mathematics, physics and chemistry in astronomy, as already instanced, must make this clear. It is therefore appropriate enough for geographers to use geological methods in their study of land forms, so long as their object is to describe the land forms instead of to recite their history; to use the methods of physical meteorology in the study of climatic values and of weather phenomena, so long as their object is to portray the sensible atmospheric conditions of a given area; to use the methods of botany and zoology in the study of plants and animals, and of anthropology, history and economics in the study of man, so long as their object is to understand better the place occupied by organized beings, and by men above all, in their homes on the earth.

Regional Geography. — If then, geography is not defined by the exclusiv ownership of the things that it studies, or by the exclusiv right to the methods of investigation that it employs, it must be, like most other sciences, defined by the object that it has in view; and that object is defined by long-establisht tradition to be a description of

the regions of the earth as they today exist. It is generally understood that the description must of course include an account of the organic inhabitants of the regions as well as of the regions themselves; and it is equally well understood, since an evolutionary philosophy has come to dominate our way of looking at the world, that the description must be explanatory instead of empirical. It is in the full attainment of these objects that the essential disciplin of our science lies. Any person who knows a region so well by long residence in it and by much travel over it that he can give an accurate account of its topography, of its climate and weather, of its soils especially as shown in its fields when plowd and as reflected in the crops that the fields bear, of its natural plant cover and its cultivated crops varying in appearance with the seasons, of its animals as they appear in the landscape, of its human inhabitants with their works and customs and activities in so far as they are related to the region — the account being so constructed as to treat each of these factors reasonably, to embody the correlations of all the factors one with another as they exist together, and to present the total picture intelligibly to a competent reader — such a person may justly call himself a geographer. Indeed, if a person is able to answer with liberal interpretation the simple question: — "What does such and such a region look like?" and answer it so completely that his hearers or readers can visualize it properly, he will be well qualified, provided he has shown his ability by publication, for membership in the Association of American Geographers, even if his description be purely empirical; but we may feel confident that it will not be, because the whole trend of geographical progress tends to make such descriptions explanatory.

Different Aspects of Geography. — The definitions of geography suggested in the preceding section apply to its regional aspect, where the effort is made to describe all the geographical elements of a given area in their totality, as they today exist together in their natural combinations and correlations; but the progress of our science has now been so great that we have come to recognize various other less comprehensiv aspects under which its larger or smaller fractions may be treated. The simplest of these is narrativ geography, in which a traveller, whether he is geographically traind or not, may record his observations in sequence of time as he makes them from day to day, without attempting to rearrange them in any other order. This kind of presentation may be either empirical or explanatory; and either in its empirical or in its mildly explanatory form it is well adapted for the entertainment and general edification of the intelligent but non-professional public.

Narrativ presentation is therefore very generally adopted in addresses at meetings of geographical societies, but unfortunately it is often so much diluted by the introduction of subjectiv personal experiences as to lose much of its objectiv value.

Another simple form of treatment is inductiv; here an observer seeks to bring together all the examples of similar phenomena that he has noted, so as to present them in the sequence of some acceptabl classification. This realizes the object of geography if it is defined as the science of distribution, but it fails to give a picture of the classified things as they exist together in nature. The climax of such treatment is found in text books of geography, where every kind of geographical object is duly described, with illustrativ examples, under some orderly arrangement. In such text books of early date, explanation was casual rather than intentional; in those of later date, explanation enters more and more thoroly and completely.

It often happens, however, that a geographer selects some special topic for his examination and treats it with greater or less thoroness apart from other matters; and this may be called topical geography: for example, the effect of the embayments of our Atlantic coast on the location of colonizing settlements, the seasonal distribution of rainfall in Florida, the floods of the Mississippi, the influence of physiographic features on the location of railways, the fault-block mountains of southern Oregon, the physiography of Nicaragua, and so on. Here again, the treatment may be either empirical or explanatory; but as a matter of fact, it is clear that the direction of progress leads toward explanatory treatment, as may be learnd by comparing topical articles of fifty years ago with those of today. Most of the oral communications made at the meetings of the Association of American Geographers are of this character; partly, no doubt, because topical presentation may be reduced, with least danger of injury to its content, to the small measure of time into which such communications have to be comprest: their treatment is, in nearly all cases, as fully explanatory as the author can make it.

It must be next noted that many geographical problems cannot be immediately given an explanatory treatment: they call for analytical investigation before a convincing conclusion can be reacht; and such investigation often involves an excursion into some non-geographical field. For example, an understanding of the rivers and valleys of Pennsylvania cannot be reacht without a discussion of their geological evolution; an understanding of the influences of coastal features on coastal people calls for a review of their historical evolution. Manifestly, therefore, if such investigations are publisht in their analytical form as

contributions to geography, they will give the impression that geography is largely either geological or historical in its nature. This would be as if a mineralogist, when attempting to analyse an unknown mineral, had to devise a new method of chemical analysis, the account of which occupies a large share of the paper in which the eventually-determined composition of the mineral itself is briefly announced; or as if an astronomer, in trying to determine the spectrum of a nebula, devoted a large part of his essay to the description of a new form of spectroscope that he devised for his purpose. But if emphasis be placed upon the results reacht, instead of upon the analytical or instrumental means of reaching them, studies of these kinds will be more manifestly related to the science which they are intended to serve. When the results attaind by such studies are so well establisht as to be generally accepted, the analytical investigation on which they were originally based may be past over briefly.

It is particularly in the treatment of physiographic problems that the complications of geological analysis are geographically distracting; and some essays of that kind reach a climax of geographical irrelevance when an author leads his readers back with him into the inferd conditions and events of the invisible geological past, and detains them there so long as to withdraw their attention from the visible geographical present. Analyses of this kind may doubtless be necessary in some cases, but if their object be geographical and not geological, the author should, when the end of the analysis is reacht, lead his readers forward again from the past into the present, by concisely stating in geographical terms the bearing of his results on present-day facts.

It may be believd that, the greater our future progress, the less frequently will analytical investigations be needed, because with increasing success in such investigations a greater and greater variety of phenomena will be brought under the explanations that the investigations establish. Laborious inductiv studies were necessary for Redfield to discover and for Loomis to confirm the cyclonic movement of the winds around progressing centers of low atmospheric pressure; we now accept their conclusions and apply them to the cyclonic phenomena of today without repeating the laborious inductiv studies on which the conclusions are based. Jukes made a careful study of the development of certain rivers and valleys in the south of Ireland, which he explaind by retrogressiv erosion along belts of weak strata; many rivers and valleys of that kind, now calld "subsequent," may today be recognized as soon as a general view over a landscape is gaind, especially in a subhumid or arid region, where the relation of understructure and surface form is well exposed.

The results reacht by physiographic analysis may be used either in the historical explanation or in the explanatory description of a region. A historical explanation proceeds in the order of time, stating the sequence of events by which the past advances into the present. Every member of the sequence must be duly presented in turn, for the successiv members are, like the links of a chain, intimately attacht to each other, fore and aft. The facts of today are not the culmination of the sequence, but simply the last link. The physiographic section of the folios issued by our national Geological Survey is, as already noted, intentionally and properly presented in the form of historical explanation, and thus belongs to geology; similarly, an explanatory review of the continued importance of the valley of the Rhone or of the Mohawk from the time of the Romans or of the Iroquois to the present day will undoubtedly lead to a better appreciation of the importance of such a valley; but the review, set forth in the order of time, belongs to history. On the other hand, an explanatory geographical description — and it is with such descriptions and not with analytical explanations that we are here chiefly concernd — ought, even if coucht in explanatory terms, to hold the attention of its readers to present conditions: if past events are alluded to at all, they should be mentiond only in a subordinate manner, not for themselves as in an historical explanation, but in order to illustrate present conditions. If such a series of past events has not been treated in their order of time by a geologist or a historian, a geographer may be tempted to give them the treatment they deserve; but in order to do so, he must leave his own field and enter the field of geology or of history. However, if he makes such an excursion, it should not be described as a trespass, as if those already cultivating the field that he enters object to his entry. To be sure, if the excursionist finds that the special problem that had tempted him out of his own field is already under investigation by a competent expert, common courtesy should lead the excursionist to withdraw; but otherwise he should be free to expend his time and energy as he pleases — unless it happens he is under contract, as a professor of geography in a university is, to cultivate his own field: in that case, excursions into other fields ought to be discouraged by his own sense of duty; for the more excursions of that kind he makes, the less work he can do in his own field.

The results reacht by analysis are open to use in still another way; for if the analytical investigation of a particular problem leads to a general understanding of the principles and processes that its solution involvs, they may be used in deductivly defining many other features related to the feature with which the investigation originated, but made

to differ from it by assigning other values to the factors involvd than those which characterize the originating feature. By assigning different values to the time factor, a whole series of type forms may be deduced, in which the originating feature will have its proper place. By then giving another value to some other factor and again running the time factor thru its permissible variations, a parallel series of somewhat different types may be deduced. The correctness of the several series of deduced types should of course be certified by confronting at least a few members of each series with observd features of appropriate kinds. The variety of well defined, ideal type forms, in terms of which corresponding actual forms may be described as occasion offers, is thus helpfully increast. For example, the various surface forms producible by the action of ordinary erosional processes on faulted structures may, after the general principles that govern the sculpturing of such structures are learnd, be treated deductivly with profit by a physiographer; similarly, it may be believd that, when a sufficient number of villages and cities have been historically studied, the conditions determining their growth and decline may be generalized, and a series of types may then be deduced from the generalization by an anthropogeographer. When that has been done, it will be as easy and as helpful to describe a certain village as activly growing and a certain city as slowly decaying — and thereby to gain a good idea of their visible appearance — as it is now to recognize and describe a certain slope as a retreating fault scarp, and another slope as a recently abandond sea cliff.

The process of thus establishing series of deduced types may be calld systematization. It is often employd unconsciously or half consciously, and therefore less successfully and less safely than if it were employd consciously and intentionally, in the preparation of systematic texts.

All these different aspects of geography with their characteristic methods of treatment, culminate in regional description. That is the goal of geographical effort. The well traind geographer should have all these aspects of his subject and all the methods of treatment at his command.

Summary. — If discouragement is sometimes felt because geography has not yet reacht a higher development among us, encouragement may be found in the assurance that it has at any rate made much progress, and that its progress is still going on. We have at least advanced from a stage when geography was anyone's and everyone's business to a stage when it is also the business of geographers. We have advanced from a day when geographical knowledge was gatherd in an almost uncon-

scious, accidental manner by untraind travellers, to a day when it is consciously and intentionally gatherd by traind experts, and when its different aspects and the various appropriate ways of treating them are coming to receive deliberate attention. We have advanced from an era when there was no opportunity for the collegiate study of geography or for the training of professional geographers, to an era when many of our colleges and universities are offering such opportunity, and in increasing measure from year to year. We have advanced from a time when geography was only a subject for elementary study, to a time when it has grown so greatly that it may well engage a man's best efforts for his whole life. If the progress thus far made is not continued, our geographers will have only themselves to blame. The discoverd but undescribed world is before them.

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